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CONTENTS.

EDITORIALS 1025
Philadelphia Section Elects Officers.....1028
A Talk on the Panama Canal.....1028
Needed Patent Reforms 1028
Rate Research Bulletin 1028
National Electric Light Association.....1029
Keokuk Power Makes Reduction in St. Louis Power Rates Possible 1031
Electric Railway Manufacturers' Exhibits.....1032
Graduate Scholarships at Massachusetts Institute of Technology 1032
Dinner to Railway Men.....1032
Proposed Increased Powers for Ontario Hydro-Electric Commission 1032
Municipal Electricians to Hold Annual Meeting.....1032
Central-Station Power for Municipal Pumping.....1033
The Availability and Adaptability of Electric Vehicles.—By W. P. Kennedy.....1043
Attractive Electric Sign in St. Paul.....1044
Conduit Versus Open Wiring for Places Exposed to Dampness or Corrosive Vapors.—By F. G. Waldenfels.....1045
Red-Lead Joints 1049
The Location of Meters.—By H. G. Wilson.....1049
New-Code Wire Required in All Sizes.....1050
LETTER TO THE EDITOR
Tinning a Soldering Iron.—By Joe Braith.....1050
Among the Contractors 1050
National Electrical Inspectors' Association.....1051
Electrical Supply Jobbers' Association Votes to Co-operate with Underwriters' Laboratories in Rubber-Covered Wire Inspection 1054
Among the Supply Men.....1054
Arkansas Association of Public Utility Operators.....1055
Committee on Organization of the International Electrical Congress in 1915.....1056
Book Review 1056
General Aspects of Industrial Lighting.—By L. B. Marks..1057
Supply of Energy for a Large Community 1060
The Illumination of the Home.—By F. A. Vaughn 1061
Electric Lighting in the Argentine Republic and Brazil.— By J. W. Tabb 1065
Symposium on Street Lighting 1068
An Analysis of Glare from Paper.—By M. Luckiesh 1070
Boston Electric Show 1072
Simplifying Induction-Meter Construction.—By H. W. Young.1073
NEW ELECTRICAL AND MECHANICAL APPLIANCES.....1074
LATEST APPROVED FITTINGS.....1080
CURRENT ELECTRICAL NEWS.....1081
RECORD OF ELECTRICAL PATENTS 1087

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CENTRAL-STATION POWER FOR MUNICIPAL PUMPING.

Among the largest potential customers for electrical energy in this country are our cities. Nearly every large city owns and operates its own water system, and in the operation of these systems large amounts of power are used. However, it has only been within recent years that this subject has been given the consideration it deserves, due perhaps to the fact that the central station, when not municipally operated, feels that the time and effort necessary to convince the municipality of the advantages of electric pumping are not worth the prospective business. It is true that, as a rule, the municipality is a difficult customer to obtain; political situations must be overcome, as well as, in many cases, a gross lack of knowledge of the true conditions surrounding the operation of the pumping plant by the municipality. Nevertheless, every effort should be extended to show the saving that can be effected through the purchase of energy developed under central-station conditions, as well as the lesser space and lower cost of maintenance of electrical pumping apparatus, as municipal pumping is a business that offers a great many attractive features from the central-station standpoint.

Of the two general systems of pumping in vogue in this country, that wherein a reservoir is provided so that water may be supplied after the pumps are shut down is the most attractive to the central station and is the easier to obtain on a profitable basis. With such a system the pumping can be very largely done at such times as best suits the load conditions of the central station and so can be made practically off-peak business, for which a very low rate can be offered with mutual profit.

In the direct system, no reservoir is provided, the rate of pumping varying directly as the demand for water. While this system does not offer so great an attraction to the central station, it must be remembered that the greatest demands for water are during the summer months when the demand for electric energy is least; thus an annual diversity-factor is offered that should make the business profitable. Some municipalities, however, in spite of the proven reliability of central-station service, lack confidence in the ability of electric service to operate the pumping machinery without interruption. In these cases, probably the best method of securing the business is by advocating a combined station, the old steam equipment to operate during peak months and moto

driven pumps to carry the regular load. This arrangement gives the central station a diversity-factor that should be most acceptable. Where the central-station can operate the water supply and install steam and electric pumps in its plant, operating a combined electric and pumping plant, ideal means are offered both the central station and the municipality for increasing the load-factor in the one case and securing continuity of service and minimum rates for the latter.

In the article on "Central-Station Power for Municipal Pumping," appearing on other pages of this issue, operating results are given from plants having direct systems, reservoirs, combination steam and electric pumping plants, and combined central stations and water works. A study of the figures presented will provide convincing arguments for the solicitor seeking this type of a motor load.

LIABILITY OF A CENTRAL-STATION COMPANY FOR BAD WIRING.

It seems to be the tendency in many municipalities to hold the electric lighting company responsible for damage and injury due to electric shock, even though the system of wiring through which the injury may have been received was not installed by the company, and, in fact, not under its direct control. In some cases the court has held that it is the duty of a company to inspect the wires and equipment, to inform itself as to whether they are safe. Where the owner of a house or some one of his family, or someone acting for him, is injured because of defective wiring or equipment in the house, the company has been held liable. This has been the ruling, even though the company is not responsible for the interior installation. This, however, has been a ruling only so far as certain courts are concerned. The latitude of the court, however, is wide, and the opportunity for effecting changes in such rulings gives the court great discretion in laying down a ruling or handing down an opinion upon so important a matter. When, however, it is sought to make such a ruling the basis of a legal statute, it seems that it is taking the alleged responsibility of the company too far afield.

Electric lighting companies do not want to connect up their services to bad systems of wiring, and this is seldom or never done if the company has had an opportunity of making a proper examination and investigation. Notwithstanding all of the safeguards that might be thrown around the connecting up of the company's service, however, there is always the pernicious amateur who will superimpose upon a properly inspected service a load for which it has not been installed, and when damage results from such interference it is beyond the bounds of reason and justice to mulct the company for the loss.

Quite recently there has been introduced in the Virginia General Assembly a bill which is framed to make the company responsible for all loss or damage to property and persons, occurring through the medium of its service, whether it or a third party installed the wiring. So unwise and apparently unfair is the substance of this bill that so conservative a person as William H. Blood, Jr., insurance expert of the National Electric Light Association, has been moved to write the following communication, which is abstracted from the May issue of the Association *Bulletin*.

"It seems to me that this bill is very drastic and that if it be enacted it will put a tremendous burden upon all electric lighting companies in the State of Virginia; in fact, it will make the electric light company the guarantor or the insurer of all inside wiring, for which it is not responsible. I do not know of any State where such a law is in force, and unless it has been passed recently, I am quite sure there is no such in force.

"I have testified in a large number of accident cases where physical injuries or where fires were alleged to have occurred through defective interior wiring, and in every case the attorney for the company has made a strong point in arguing that the lighting company is not an insurer of the wiring on the customer's premises, and this point has had great weight. In every case of this nature with which I am familiar, where the company has been held liable for accident or injury, the burden of the proof has been for the customer or the insurance company to show that the electric lighting companies were negligent in the manner in which they kept their outside wires. Getting at this from a practical point, how would it be possible for a lighting company to keep track of additions or changes in the wiring of their customers? Inexperienced wiremen and boys might, without the knowledge of the lighting company, make additions or alterations, and even if the company made a monthly inspection of each of its customers, an accident or injury might occur the day after the inspection was made. The making of even a monthly inspection would bring about a cost which would be prohibitive.

"The company would also have to be the one to determine 'the safety and sufficiency' of the wires, fixtures, etc. It does not seem to me that a lighting company should be required to do this any more than that the Standard Oil Company should be required to pass upon the kind of oil lamps their kerosene should be used in, or that the manufacturers of gunpowder should be required to insure the different kinds of guns or revolvers that their explosive might be used in."

We are in favor of rigid inspection and approve all other means for rendering the generation and merchandising of electrical energy safe to the consumer, but where the tendency of flexible rulings appears to be directed unreasonably against the interests of the electric lighting company, and where this tendency is liable to become shifted into an inflexible statute, we believe that such a proceeding should be fought against most vigorously.

ELECTRIFICATION IN CHICAGO.

The study of conditions affecting electrification of steam-railroad terminals has received considerable attention in several cities, such as New York and Boston, but probably nowhere has such a thorough investigation of the subject been made as is now in progress in the city of Chicago. This investigation is being made by the Committee on Smoke Abatement and Electrification of the Chicago Association of Commerce. This committee was appointed about a year ago, and in addition to members of the Association, it includes representatives of the City Government and of the railroads. A staff of expert engineers was appointed and the investigation being made includes a determination of the necessity of changing the motive power of steam railroads, the technical feasibility of such a change and the financial practicability of the same.

At a recent meeting of the Association of Commerce the work of this committee was described by its engineers and the completeness of the investigation under way was made very evident. The study of the present conditions as regards smoke includes not only an examination of the smoke densities being emitted by the stacks of locomotives and stationary plants, but also a survey of the air which is carried on by means of local analyses of the air in various parts of the city made by means of a portable laboratory installed in a motor vehicle.

The transportation problems of the railroads as regards both passenger and freight traffic are undergoing careful study. As Chicago is the greatest railroad center in the world, with an average of 1,673 locomotives in daily operation and not less than 105 separate railroad yards, this constitutes a gigantic problem. Moreover, in addition to the local freight to be handled, there is a great quantity of through freight which passes through the city, requiring transfer from one railroad system to another. The investigations of the committee are unique, since they constitute the first attempt to develop a uniform plan of terminal electrification for a large number of independent railroad companies and in that they will include the electrification of all tracks used for any railroad purpose within the city limits. For all of this traffic the size and weight of trains, the mileage covered, the number and frequency of stops and the distribution of the movements in both time and space must be carefully determined before any estimate can be made of the power requirements for electric operation. In order to accomplish this, daily records of present locomotive service are being obtained, including the amount of coal consumed and for what purpose utilized. There were no existing records which would cover these facts.

The investigation also includes a study of the liability of accident and personal injury from different forms of operation, the effect upon the health of smoke, both from locomotives and other sources, the comparative comfort and convenience of operation by different kinds of motive power, comparative damage to property and the comparative merits of operation by steam locomotives, internal-combustion engines, compressed air and electrical drive by storage battery and by third-rail or trolley distribution. It will be evident that a tremendous amount of work is involved in this investigation and that considerable time will be necessary in order to complete it. When the study has been made, however, more information will be available than has ever before been collected in connection with any problem of electrification on such a large scale.

Electrical engineers will surely look forward with confidence to a decision that electrical operation will not only prove the most suitable from an engineering standpoint, but that it will be the most convenient and practical relief from the smoke nuisance, which is now such a detriment to Chicago.

CONCERNING FLEXIBLE CORD.

One sometimes hears electrical inspectors express the hope that the day may speedily come when the use of flexible cord in electric service will be discontinued. It is probable, however, that such expressions are provoked by difficulties encountered in preventing the improper use of material of this sort oftener than by any desire to prohibit the use of it altogether; for it seems to be very hard, if not, indeed, impossible, to keep inexperienced persons from using cord in ways that were never intended by the manufacturers, and which, moreover, are sometimes anything else than safe. For example, circuits are run by nailing it on some surface or other with metal staples, or, perhaps, cord designed for pendent service is used where only portable cord should be employed. Flexible cord fills a highly useful place in the electrical industry, and will doubtless continue to do so for a long time to come, but the improper use of it should be discouraged in every possible way. And electricians and retail dealers in wiring materials can do more toward insuring the correct use of it, it would seem, than can be accomplished by even inspectors themselves.

It is interesting to note in this connection that the new-code flexible cord, that is, the cord specified by the 1911 edition of the National Electrical Code, is now being supplied by a large number of the manufacturers of wire, and that its adoption will soon begin to be enforced by inspection bureaus. In Chicago the old-code cord will not be approved after July 1. When the matter of fixing the time for discontinuing the approval of old-code rubber-covered wire came up for consideration at the meeting of the Western Association of Electrical Inspectors last winter, it was decided not to take any action then concerning flexible cord and fixture wire, there being a feeling, apparently, that complications might arise from a lack of supply of the new product. The records of the Underwriters' Laboratories indicate now, however, that there will be no trouble on this account.

Philadelphia Section Elects Officers.

The regular meeting of the Philadelphia Section of the Illuminating Engineering Society was held on May 17. Preceding the meeting a dinner was held at the Bingham Hotel, which was attended by 110 members and visitors. The meeting was attended by 187 members and visitors.

The election of officers for the ensuing year resulted as follows: Chairman, A. J. Rowland; secretary, L. B. Eichengreen; managers, J. D. Israel, F. N. Norton, R. F. Pierce, George A. Hoadley, E. B. Gillinder.

Mr. Hartley, on behalf of the membership, presented Mr. Israel with a bouquet of roses as a mark of appreciation of Mr. Israel's work as chairman.

Prof. Rowland delivered the paper of the evening on "Calculation of Illumination, and Principles of Photometry." The paper was illustrated by a number of demonstrations and lantern slides.

C. O. Bond gave a demonstration of various lighting standards, including the open candle, the pentane lamp and others. The paper was discussed by E. L. Simmons, H. Thurston Owens and others.

This is the last meeting of the Section for the season.

A Talk on the Panama Canal.

At a meeting on May 24 of the Chicago Alumni of the University of Wisconsin at the Grand Pacific Hotel, an address was made by R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company, upon "The Panama Canal."

Mr. Schuchardt was one of those who took the recent trip to the Isthmus of Panama with the American Institute of Electrical Engineers, and he gave a most interesting and glowing account of the work and conditions upon the Isthmus, paying particular attention to the engineering features. The address was illustrated with lantern slides.

Iron and Steel Engineers to Incorporate.

The Association of Iron and Steel Electrical Engineers will apply for a state charter in Pennsylvania on June 15, notice having been filed by Solicitor B. H. Feldstein. The incorporators are H. H. Laughlin, E. Friedlander, Frank W. McKee, C. A. Menk and J. S. O'Donovan.

Pittsburgh Telephone Rates.

The Chamber of Commerce, Pittsburgh, Pa., is making an investigation regarding the rates of the local telephone company, as there have been many complaints that the present rates are inequitable.

Needed Patent Reforms.

At a special noonday dinner and meeting of the Electrical League of Cleveland, held in the assembly room of the Hollenden Hotel on May 20, the League had the pleasure of listening to Ralph D. Mershon, of New York City, the newly elected president of the American Institute of Electrical Engineers, who spoke on the subject, "Needed Improvements in the United States Patent System." Mr. Mershon was present by courtesy of the Cleveland Section of the American Institute of Electrical Engineers. After explaining in considerable detail what he considered to be the main defects of the present system of obtaining and adjudicating patents, the speaker urged upon his audience the desirability of having the entire situation investigated by a commission of professional men of high standing who should draw up practical recommendations for changes. Mr. Mershon stated that he and Henry L. Doherty some time ago had a prominent part in the organization of the Inventors' Guild, a body consisting at the present time of 32 prominent inventors, and that the Guild is giving a great deal of attention to the matter of patent reform and has reached the unanimous conclusion that it is for the best interest, not only of the inventors but of the country at large, that a commission should be appointed by the President of the United States. Mr. Mershon urged that organizations like the Electrical League of Cleveland and the Sons of Jove should exert their influence in bringing to the attention of President Taft, through Congress, the need for such a commission.

S. E. Doane, chairman of the meeting, introduced R. L. Jaynes, of Pittsburgh, after the conclusion of Mr. Mershon's address. Mr. Jaynes, speaking as reigning Jupiter of the Order of Rejuvenated Sons of Jove, said that he believed that that organization could probably co-operate in a very helpful way with the Inventors' Guild and with all persons interested in the readjustment of patent conditions, for the Jovians are practically seven thousand strong, and any concerted action that they take must necessarily carry a great deal of weight. Mr. Jaynes was followed by M. H. Moffett, who spoke in the interests of local Jovians.

Pittsburgh Jovian Meeting.

At the meeting of the Pittsburgh Jovians at the Fort Pitt Hotel on May 16, an address was made on "Co-operation," by Charles Bregg, dramatic critic of the Pittsburgh *Gazette-Times*. Plans for entertainment during the annual convention of the Sons of Jove to be held in Pittsburgh, Pa., October 14, 15 and 16 were also discussed.

Rate Research Bulletin.

The Rate Research Committee of the National Electric Light Association, in collating and compiling the vast amount of data which came into its office early in the year, reached the conclusion that much of the data so received had an immediate value and should be promptly given out to the member companies.

On January 17, the Committee issued a four-page mimeographed memorandum which it decided to continue weekly as the Rate Research Bulletin. Starting with a mailing list of about thirty member-company assistants, the bulletin has grown to six or seven pages with a mailing list of about one hundred, which is the extreme limit under the present process of producing it.

Its circularization would be increased to about three hundred if all the requests for copies could be considered and at the Seattle convention, the Rate Research Committee will ask the Executive Committee for authority to continue its publication and it may possibly be enlarged and even printed.

The Bulletin attempts to collate all electric-rate information with special attention to new electric rates as they are adopted in the various cities. The decisions of courts and commissions are abstracted, direct quotation being given from important paragraphs or digests. In addition to this, a complete list of the current references relative to electric rates and electric rate regulation is given on the final page. In the early issues, the principal references for 1910 and 1911 were brought up to date.

Electrification of London Railways.

Extensive plans for the electrification of the London suburban railway lines are under serious contemplation. These involve the substitution of electricity for steam on some hundreds of miles of railways in the London district, and it seems certain that the next few years will, for all practical purposes, see the end of the long reign of steam for traction purposes on the suburban routes serving the metropolis. The advantages of electrical operation for handling such traffic have been so completely demonstrated that the question has largely passed out of the technical into the financial phase. In some cases the terms on which the necessary capital for conversion could be raised are such as to induce railway boards to postpone the work of electrification until the latest possible date, and in no instance is the provision of the large funds for electrification simple.

The railways which are considering the subject of electrification of portions of their lines are the Great Eastern, the Midland, the Great Northern, and the Lancashire & Yorkshire.

National Electric Light Association.

Thirty-fifth Convention, Seattle, Wash., June 10-13.

The thirty-fifth convention of the National Electric Light Association will be held at Seattle, Wash., June 10, 11, 12, and 13. The convention sessions will be held on Tuesday, Wednesday and Thursday. The convention will begin on the evening of June 10 with a reception and the opening of the exhibition at the Seattle Armory. The following program has been announced for the general, executive, technical, accounting, commercial, power transmission public session of the convention:

Tuesday, 10 a. m.

First General Session:

1—Welcome to the City; 2—Address of President Gilchrist; 3—Announcements; 4—Report of Committee on Organization of the Industry—H. H. Scott; 5—Report of Secretary—T. C. Martin; 6—Report of Insurance Expert—W. H. Blood, Jr.; 7—Report of Committee on Progress—T. C. Martin; 8—Report of Library Committee, Report of Handbook Committee—Arthur Williams; 9—Report on Question Box—E. A. Edkins; 10—Paper: "Expanded Loyalty"—Paul Lüpke.

Tuesday, 2:30 p. m.

First Commercial Session:

1—Address of Chairman of Section—H. J. Gille; 2—Address: "Commercial Development of the Electrical Industry"—W. W. Freeman; 3—Report of Committee on Membership—George Williams; 4—Report of Committee on Steam Heating—S. M. Bushnell; 5—Report of Committee on Electric Refrigeration and Ventilation—John Meyer.

Tuesday, 2:30 p. m.

First Accounting Session:

1—Report of Committee on Uniform Accounting—E. J. Bowers; 2—Paper: "Incandescent Lamp Accounting of the New York Edison Company"—W. H. Bogart; 3—Paper: "Handling and Accounting for Scrap Materials"—C. E. Bowden; 4—Paper: "General Filing Systems"—R. H. Williams.

Tuesday, 2:30 p. m.

First Technical Session:

1—Report of the Meter Committee—O. J. Bushnell; 2—Paper: "Meter Setting"—S. D. Sprong; 3—Report of Committee on Grounding Secondaries—W. H. Blood, Jr.; 4—Report of Lamp Committee—F. W. Smith; 5—Report of Committee on Electrical Measurements and Values—A. E. Kennelly (to be read with Lamp Report); 6—Paper: "Line Voltage"—R. E. Campbell.

Tuesday, 8:30 p. m.

First Power Transmission Session:

1—Address of Chairman—Henry L. Doherty; 2—Report: "The Use of Electricity for Irrigation and Agricultural Purposes"—C. H. Williams (Illustrated by lantern slides and motion pictures).

Tuesday, 8:30 p. m.

Second Commercial Session:

1—Report of Committee on Residence Business—J. B. Becker; 2—Report of Committee on Industrial and Commercial Lighting—E. H. Beil; 3—Report of Committee on Competitive Illuminants—F. H. Golding; 4—Report of Committee on Electric Advertising and Decorative Street Lighting—W. H. Hodge.

Wednesday, 10 a. m.

Second General Session:

1—Report of the Rate Research Committee—E. W. Lloyd; 2—Paper: "The Desirability as a Central-Station Load of Pumping for Municipally Owned Water Works"—C. A. Munroe; 3—Paper: "Educating Central-Station Employees"—H. E. Grant. (To be discussed in Company Section Meeting, Thursday afternoon.

John F. Gilchrist,
President, National Electric Light Association.

Executive Session (12 or 12:30):

1—Action on Report of Public Policy Committee—Arthur Williams; 2—Presentation of Proposed Constitutional Amendments—Frank W. Frueauff; 3—Report of Treasurer—G. H. Harries: 4—Election of Nominating Committee.

Wednesday, 10 a. m.

Second Technical Session:

1—Report of the Committee on Terminology—W. H. Gardiner, Jr.; 2—Paper: "New Current-Consuming Devices"—F. N. Jewett; 3—Paper: "24-Hour Service in Small Central Stations"—Taliaferro Milton; 4—Report of Committee on Overhead Line Construction—Farley Osgood.

Wednesday, 10 a. m.

Second Accounting Session:

1—Paper: "Proper Accounting for the sale of Electric Devices"—L. M. Wallace; 2—Paper: "Scientific Management of an Accounting Department"—Franklyn Heydecke; 3—Paper: "Central-Station Motor-Vehicle Costs and Their Distribution to Accounts Benefited"—E. C. Scobell.

Wednesday, 2:30 p. m.

Second Power Transmission Session:

1—Paper: "Work and Publications of the United States Government Relating to Hydroelectric Development"—J. S. Hoyt; 2—Report of Power Transmission Committee of the Association—J. R. McKee; 3—Report of Committee on Power Transmission Progress—T. C. Martin; 4—Paper: "Switchboard Practice for High-Tension Power Transmission"—Stephen Q. Hayes.

Wednesday, 2:30 p. m.

Third Commercial Session:

1—Report on Electric Vehicles—L. R. Wallis; 2—Report: "Electricity in Rural Districts"—J. G. Learned; 3—Paper: "A Plan for Increasing Power Load"—H. W. Cope; 4—Report: "Selling Current to Larger Power-Users"—Joseph Lukes.

Wednesday, 2:30 p. m.

Third Accounting Session:

1—Paper: "Regulated Electric Light Accounting"—H. M. Edwards; 2—Paper: "Progress Made in the Uses of the Tabulating Machine"—Mr. Schmidt, Jr.

Wednesday, 8:30 p. m.

Public Policy Session:

1—Musical Program; 2—Reading of Report of Public Policy Committee—Arthur Williams; 3—Report of the Medical Commission of Resuscitation from Shock—W. C. L. Eglin; 4—Lecture: Electrification of the Panama Canal (illustrated by lantern slides).

Thursday, 10 a. m.

Fourth Commercial Session:

1—Report of Committee on Cost of Commercial Department Work—E. L. Callahan; 2—Report of Committee on Contract Order Routine—T. I. Jones; 3—Report of Committee on the Commercial Index—E. L. Callahan; 4—Paper: "Ozonators and Their Exploitation by the Central Station"—M. O. Troy.

Thursday, 10 a. m.

Third Technical Session:

1—Report of Committee on Prime Movers—I. E. Moultrop; 2—Report of Committee on Electrical Apparatus—L. L. Elden; 3—Report of Committee on Underground Construction—W. L.

Abbott; 4—Paper: "Care and Operation of Transformers"—W. M. McConahey.

Thursday, 2:30 p. m.

Third Power Transmission Session:

1—Report of Committee on Receiving Apparatus for Use on Transmission Lines—F. B. H. Paine; 2—Paper: "Corona on High-Tension Lines"—G. Faccioli; 3—Report of Committee on Protection from Lightning and Other Static Disturbances—S. D. Sprong; 4—Topical Discussions (time permitting).

Thursday, 2:30 p. m.

Third General Session and Executive Session:

1—Paper: "Some Uses of Metals"—W. R. Whitney; 2—Report of the Committee on Electrical Apparatus—L. L. Eldew; 3—Report of the Committee on Memorials—T. C. Martin; 4—Report of the Committee on Constitutional Amendments—Frank W. Frueauff; 5—Vote on Constitutional Amendments;

Frank M. Tait,
First Vice-President, National Electric Light Association.

6—Report of Nominating Committee; 7—Election of Officers; 8—Adjournment.

Thursday, 3 p. m.

Company Sections Session:

1—Report of Committee on Award of Doherty Gold Medal—W. W. Freeman; 2—Discussion of Grant Paper; 3—The Proposed Company Section Lecture Bureau—T. C. Martin; 4—Experience Meeting as to Company Section Work.

The officers of the National Electric Light Association are:

President, John F. Gilchrist.

First Vice-President, Frank M. Tait.

Second Vice-President, Arthur S. Huey.

Secretary, T. Commerford Martin.

Treasurer, George H. Harries.

Executive Committee, J. Abbott, H. M. Byllesby, John Cavanaugh, W. R. Collier, A. A. Dion, Alex Dow, W. C. L. Eglin, Charles L. Edgar, Dudley Farrand, W. W. Freeman, John F. Gilchrist, H. A. Holdredge, Arthur S. Huey, S. P. Hunt, R. S. Orr, H. T. Sands, H. H. Scott, C. A. Stone, F. M. Tait, Herbert A. Wagner, Arthur Williams.

Exhibition Committee, J. C. McQuiston, chairman; James I. Ayer, Charles Blizard, S. E. Doane, Frank H. Gale, W. A. Layman, H. G. McConnaughy, J. W. Perry, Philip L. Thomson, Walter Neumuller, secretary and treasurer.

Under the direction of Charles H. Hodskinson, master of transportation, several special trains have been arranged to bring the delegates from the east and south.

One of the notable trains is the "Red Special," which left New York on May 26 and which will visit the Grand Canyon of Arizona, Southern California, San Francisco, Portland, Yellowstone Park, Salt Lake City, the Colorado Rockies, Colorado Springs and Denver. This train is due to arrive at Seattle at 2 p. m., June 9. Leaving Seattle at 11 p. m., June 14, it is due to arrive at New York at 9 a. m., June 29. This train is under the direction of George W. Elliott, New York Master of Transportation, with Charles B. Burleigh in charge of the New England Section.

Following its customary courtesy the Wagner Electric Manufacturing Company, through the genius of Ray D. Lillibridge, provided a handsome "train directory" and furnished candies and flowers in profusion for the ladies and cigars and cigarettes for the gentlemen. The company also provided a photographer for a group picture of the train and party and presented each member of the party with an appropriate souvenir.

George W. Higgins is in charge of the "Red Special," representing the New York Central Lines.

Among those on the "Red Special" are the following:

Mr. and Mrs. J. R. Crouse, Mr. and Mrs. H. A. Tremaine, Ray D. Lillibridge, Mr. and Mrs. F. M. Tait, Mr. and Mrs. Charles Wuichet, Mr. and Mrs. A. E. Carrier, Mr. and Mrs. H. B. Logan, Mr. and Mrs. R. W. Charles, Mr. and Mrs. T. E. Murray, Mr. and Mrs. John W. Lieb, Jr., Miss Julia Engler, Miss Graham, Mr. and Mrs. John R. Graham, Arthur Williams, Mr. and Mrs. S. C. D. Johns, Mr. and Mrs. E. J. Bechtel, Mr. and Mrs. T. Beran, Mr. and Mrs. George W. Elliott, Mr. and Mrs. Charles H. Hodskinson, G. T. Manson, Leslie C. Love, Mr. and Mrs. J. W. Howell, Mr. and Mrs. D. C. Shain, Mr. and Mrs. George W. Higgins, J. B. Seaman, B. Frank Day, R. S. Hale, Mr. and Mrs. S. G. Rhodes, S. E. Doane, Mr. and Mrs. E. W. Lloyd, Mr. and Mrs. Arthur B. Huey, Mr. and Mrs. J. B. McCall, Mr. and Mrs. C. L. Bundy, Mr. and Mrs. A. H. Manwaring, Mr. and Mrs. H. T. Paiste, Mr. and Mrs. Norman Macbeth, F. W. Sanford, J. O. Montignani, T. H. Yawger, A. Parshall, Stuart Wilder, W. E. G. Mitchell, H. Inches, Newton W. Leidy, W. W. Freeman, T. I. Jones, Charles Horstman, A. A. Brown, W. S. Rugg, T. J. Pace, Mr. and Mrs. Philip S. Dodd, A. W. Hellis, E. C. Brown, M. M. Eckhardt, T. E. Bibbins, E. O. Shreve, Mr. and Mrs. J. Brodie Smith, Daniel Goss, D. C. Goss, Mr. and Mrs. F. J. Whiting, Mr. and Mrs. Charles B. Burleigh, Mr. and Mrs. W. R. Eaton, Mr. and Mrs. James I. Ayer, Mr. and Mrs. George R. Stetson, Mr. and Mrs. W. J. Keenan, Mr. and Mrs. A. M. Barnes.

Another train, leaving New York on June 3 and Chicago on June 4, under the direction of J. C. McQuiston and G. A. Freeman, will arrive at Seattle on June 9, at 9:30 p. m. This train will visit Banff Hot Springs, Lake Louise, through the Canadian Rockies to the Glaciers, Fraser Canyon to Vancouver, thence, by steamer to Victoria and Seattle.

On this tour, train 1, or the "Pink Special," under the direction of Mr. McQuiston, the following reservations have been made:

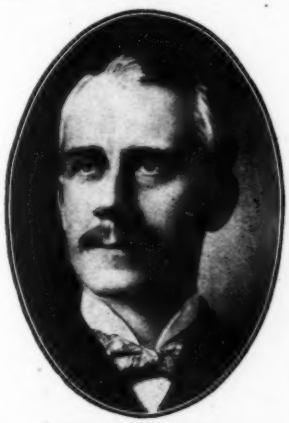
T. C. Martin,
Secretary, National Electric Light Association.

L. A. Osborne, S. L. Nicholson, G. B. Griffin, J. C. McQuiston, C. S. Cook, L. L. Warfield, S. Q. Hayes, E. A. Thornwell, G. C. Ewing, B. F. Ott, R. S. Orr, Mr. and Mrs. S. L. Tone, Van Dusen Rickert, Mr. and Mrs. Harry M. Hope, Mr. and Mrs. L. R. Wallis, R. J. McClelland, Jos. F. Becker, Mr. McCoy, Mr. and Mrs. E. Z. Wallower, J. H. Donlan, E. M. Podeyn, A. A. Pope, F. H. Kinnicutt, A. Hertz, Miss N. Keinz, E. F. Tweedy, W. H. Whitton, C. K. Nichols, Mr. and Mrs. G. A. Graves, E. E. Gilbert, F. D. Pembleton, Mr. and Mrs. W. R. Burrows, F. F. Fowle, A. E. Clifford, J. C. Woodsome, Mr. and Mrs. Arthur B. Lisle, Mr. and Mrs. A. Anderson, R. E. Hamilton, F. H. Sherwood, Mr. and Mrs. Farley Osgood, Mr. and Mrs. W. K. Vanderpoel, Ward Harrison, Miss Ward, Mr. and Mrs. M. O. Troy, R. B. Parker, George W. Brine, Mr. and Mrs. Dudley Farrand, Mr. and Mrs. F. W. Lawrence, F. M. Farmer, Mr. and Mrs. Paul Spencer, Mr. and Mrs. J. B. Klumpp, John Mustard, Mr. and Mrs. E. S. Marlow, Mr. and Mrs. L. E. Sinclair, W. C. L. Eglin, Miss Jane Eglin, R. E. Moore, Mr. and Mrs. J. J. Gibson, Mr. and Mrs. John L. Mather, D. A. Ber-

tolette, Mr. and Mrs. J. F. Klumpp, Harold Goodwin, P. S. Young, Douglass Burnett, R. H. Tillman, E. Robertson.

On the same tour, Train 2, or the "Green Special," under the direction of Mr. Freeman, the following reservations have been made:

C. W. PenDell, H. L. Judd, Mr. and Mrs. Rufus E. Lee, E. A. Edkins, J. G. Learned, Mr. and Mrs. C. I. Hall, Mr. and Mrs. L. H. Conklin, Mr. and Mrs. T. P. Gaylord, Mr. and Mrs. F. A. Bryan, G. H. Atkin, H. B. Gay, H. E. Addenbrooke, Mr. and Mrs. H. B. Gear, F. C. Vaughn, N. R. Birge, H. Wright, W. R. White, M. L. Eastman, M. M. McGovern, Mr. and Mrs. F. N. Boyer, Mr. and Mrs. H. E. Niesz, Mr. and Mrs. T. F. Grover, Mr. and Mrs. G. A. Freeman, S. Gardner, J. Hecht, Mr. and Mrs. C. A. Lind, Mr. and Mrs. A. D. Bailey, Mr. and Mrs. H. L. Gannett, F. S. Pratt, Mr. and Mrs. A. S. Pratt, Mr. and Mrs. W. H. Blood, Jr., Mr. and Mrs. O. J. Bushnell, Mr. and Mrs. J. C. Brett, J. H. Goehst, Mike S. Hart, William McGregor, Mr. and Mrs. C. W. Hough, W. D. McDonald, Ludwig Kemper, Mr. and Mrs. H. J. Gille, and Miss Gille, L. L. Elden, J. W. Cowles, N. C. Cotabish, J. F. Kerlin, W. M. Skiff, Mr. and Mrs. W. D. Ray, Mr. and Mrs. P. H. Korst, W. A. Wadsworth, H. B. McVicker, D. L. Davis, Mr. and Mrs. S. B. Way, H. S. Knowlton, Miss Mae B. Callahan, J. J. Wiley, Mr. and Mrs. A. W. Leonard and Miss Leonard, G. C. Osborn, C. J. Zweck, L. L. Tissier,



George H. Harries,
Treasurer, National Electric Light Association.

H. L. Wallace, H. J. Davis, George E. Dunn, W. G. Willard, J. C. Gapon, G. M. Pierce, H. W. Young, S. L. Whitestone.

The "Orange Special," also under the direction of G. A. Freeman, will leave Chicago on June 6 at 4:30 p. m., arriving at Seattle, June 9, at 2:30 p. m. On this train the following reservations have been made:

Mr. and Mrs. W. H. Hodge, Mr. and Mrs. E. L. Callahan, Mr. and Mrs. Harold Almert, Arthur S. Huey, Paul Doty, A. D. Page, Hugh M. Wilson, H. L. Monroe, C. W. Stone, F. G. Baker, J. W. Gillette, A. E. Smith, J. R. Strain, Thomas A. Grist, Mr. and Mrs. R. W. Harms, G. P. Edmonds, S. B. Cushing, R. J. Kelley, M. J. Kenny, H. O. Channon, V. N. Gurney, D. F. Burritt, N. C. Hurley, E. N. Hurley, Jr., T. K. Jackson, W. D. Steele, Mr. and Mrs. J. P. Ohmer, W. E. Keily, Ralph Beman, Mr. and Mrs. H. C. Hoagland, H. J. Gonden, L. G. Gresham, A. A. Gray, Mr. and Mrs. Fred Wardell, C. L. Williams, B. W. Cowperthwait, A. Larney, W. N. Ryerson, Mr. and Mrs. J. B. Crane, E. L. Clark, Miss Clark, Mr. and Mrs. F. A. Otto,

Another special train, under the direction of H. Spoehrer, leaves St. Louis

Arthur S. Huey,
Second Vice-President, National Electric Light Association.

on June 5, at 9:04 a. m., arriving at Seattle on June 9, at 8:15 p. m. The other special takes care of lower California and San Francisco, and is in charge of E. B. Strong. On the St. Louis train the following reservations have been made:

A. C. Einstein, H. Spoehrer, John Hunter, S. H. Wallace, William Gallaher, R. J. Russell, George D. Rosenthal, F. N. Jewett, C. W. Wilkins, John B. Bell, J. J. Frey, R. E. Campbell, O. H. Caldwell, E. J. Bowers, Harry G. Glass, Louis H. Egan, J. S. Tritle, Miss M. Russell, Mr. and Mrs. D. H. Cornell, O. Ripley, W. H. Fellows, H. H. Dickinson, C. F. Farley, H. H. Stephens, P. A. Bertrand, George H. Waring, P. W. Markham, Mr. and Mrs. A. G. Curtiss, L. L. Warfield, B. F. Eyer, Mr. McMasters.

The secretary of the association, T. C. Martin, the secretary of the Exhibition Committee, Walter Neumuller, his assistant, Joseph B. Murray, and Miss Burkhalter, Miss Burgoyne, Miss Burseil and Miss Van Court, from the executive offices of the Association, were passengers on the "Red Special" from New York to Chicago. From that point they proceeded by fast train to Seattle to arrive early on the scene of activities to prepare for the work of registration and other preliminaries.

An elegant, leather-bound eighty-page booklet was the souvenir presented by the National Quality Lamp Division of the General Electric Company, Cleveland, O., to each of the delegates travelling to the convention on the special convention trains. The title of the brochure is "A Little Journey" —reminiscent of certain of Elbert Hubbard's literary works—and its introduction was written by no less person than "Fra Elbertus" himself.

The main text, which follows directly after a brief analysis of present electric train-lighting methods, by C. W. Bender, consists of terse descriptions of notable points of electrial interest along the routes of the trains, this material being arranged in the form of a diary, with blank lines for memoranda to be filled in by the tourist. The book is profusely illustrated with views of power houses, dams, transmission lines, street-lighting installations, etc., selected from a collection of about three hundred such views.

Keokuk Power to Reduce Power Rates in St. Louis.

The Union Electric Light & Power Company, St. Louis, Mo., is distributing an attractive booklet calling attention to the new power rates which the company will soon be able to establish as a result of purchasing power from the hydroelectric plant at Keokuk, Ia. The new rates specify that the requirements of the customer must be equal to a demand of 200 kilowatts. The energy sold will be measured on the primary

J. C. McQuiston,
Chairman Exhibition Committee, National Electric Light Association.

side and the purchaser will provide or pay for transformer installation. The net rate for this energy will be $20 per kilowatt per year for the first 200 kilowatts of demand, and $15 per kilowatt demand per year for all excess, plus an energy charge of one-half cent per kilowatt-hour. Comprehensive distribution plans have been worked out, providing in their operation that all parts of St. Louis available for manufacturing purposes shall be served.

The booklet comments on the value to a city of cheap power and also on the esthetic value of water power which is not only cheap but provides a means for greatly reducing the smoke evil.

Electric Railway Manufacturers' Exhibits.

The arrangements for the exhibits to be held by the American Electric Railway Manufacturers' Association in connection with the Chicago convention to be held October 7 to 11 comprise the following scheme.

For the arena the plan adopted some years ago for the front building at Atlantic City will be carried out as far as possible, making this a general meeting place.

The arena gallery or mezzanine floor is only about ten feet from the arena floor and will overlook the entire arena, having steps at each end. Only exhibits which do not require wall space will be placed on this floor.

In the north pavilion will be a room devoted to frog, switch and track exhibits. In the south pavilion manufacturers having a working exhibit or requiring power will be located.

The signal exhibits will be located in the south straightaway, which has wall space and a ceiling 25 feet high. The north straightaway will be devoted to manufacturers requiring wall space.

The entire equipment of decorations is new and from an artistic standpoint will surpass anything arranged in previous years. In fact the entire exhibition is expected to surpass anything previously attempted.

Graduate Scholarships at Massachusetts Institute of Technology.

The Committee on Graduate Scholarships has recommended scholarships for R. D. Huxley, A. L. Matte, L. C. Tomlinson, E. L. Bray and H. E. Dexter, who are candidates for advanced degrees in electrical engineering at Massachusetts Institute of Technology. Three of these young men are candidates for the degree of Doctor of Engineering. The popularity of the post-graduate study of electrical engineering at the Institute continues to increase. A number of master's degrees in electrical engineering will be granted this year.

Pittsburgh Illumination.

More than $50,000 was spent for electrical decorative illumination, exclusive of flags and bunting, in decorating Pittsburgh buildings for the fifty-ninth annual state conclave, Knights Templar, which was held in Pittsburgh, Pa., May 27, 28 and 29. The Allegheny County Light Company used over 1,600 lamps in one set piece alone, while the First National Bank building, Pittsburgh's newest sky-scraper, hung its walls with streamers of electric lights extending from the cornice to the pavement, over 325 feet.

Dinner to Railway Men.

The feature of a dinner given in honor of officers of the American Electric Railway Association by President George H. Harries, of the Louisville Lighting Company, at the Seelbach Hotel in that city on May 24, was the declaration by most of the speakers that the day has passed when the public-service corporation may keep the facts about its business entirely to itself. In introducing President Thomas N. McCarter, General Harries, who presided as toastmaster at the dinner, said that the public-service company must take the public into its confidence and that the solution of questions confronting both the companies and municipalities lies in the proper use of this relation.

President McCarter devoted a good deal of time to the discussion of street-railway fares, indicating that a sliding scale will ultimately have to be adopted, for there is evidently a limit, he declared, to the distance which a passenger may be carried for five cents. Mr. McCarter said that conditions in Louisville are fair and that public sentiment is more reasonable than in most sections of the country. He suggested that 20 years is too short a period, in many cases, for the operation of public-utility franchises.

E. J. McDermott, lieutenant-governor of Kentucky, also spoke. The dinner was attended by 40 prominent business men and public-service-corporation officials.

Proposed Increased Powers for Ontario Hydro-Electric Commission.

A bill has been introduced in the Provincial Parliament of Ontario, Canada, conferring on the Ontario Hydro-Electric Commission the following additional powers, among others:

To take over existing power-transmission lines and to improve water powers, by assisting municipalities and others in the storage of water, making of sluices, etc.; to regulate the installation of electrical equipment and of wires in all buildings, including private houses; to control absolutely light and power rates charged by municipalities whether these municipalities take power from the Commission or not; to direct the disposal of surpluses earned by municipal power plants supplied by the Commission; to order all wires under its jurisdiction to be laid underground in cities and towns; with the co-operation of the Dominion Railway Commission, to order to be laid underground all wires in streets where the municipalities construct tunnels or conduits to carry such wires.

Electrically Operated Mines.

Although the Eastern Kentucky coal field is the newest of the large producing districts, it is unique in the rapidity with which electrical equipment has been installed. Not only are most of the new mines being electrically operated, but many of the old ones which have been using either hand-power or steam plants are substituting electric current in their operations. In addition to the use of electricity for general power and haulage purposes, operators are running their conveying systems and washers with large motors and are also operating their cutting machines electrically. As there is almost no gas formed in the Eastern Kentucky mines, there is no fire hazard created by the use of electricity. Many new railroads are being completed into that section and scores of new mines will be opened up.

The Solar Eclipse and Radio-telegraphy.

During the recent solar eclipse an interesting test was undertaken between the radio station of the Royal Dock Yard in Copenhagen and the Blaavandshuk station on the coast of Jutland, so as to ascertain the effect of the eclipse upon wireless transmission. It transpired that the telegraphing became more distinct and reliable as the eclipse progressed, and that it was most distinct shortly after the culmination of the eclipse. The view that it is the effect of the solar light upon the atmosphere which is the cause of radio-telegraphy being much better at night than during the day was thus confirmed.

Municipal Electricians to Hold Annual Meeting.

The seventeenth annual convention of the International Association of Municipal Electricians will be held at Peoria, Ill., August 26 to 30. The Jefferson Hotel will be the official headquarters. Ample space will be provided for exhibits, and applications for exhibit space should be addressed to W. E. Walgamott, city electrician, Peoria, Ill,

The proceedings of the sixteenth annual convention, held last year, have been printed and distributed by the secretary, Clarence R. George, Houston, Tex.

Pittsburgh Jovians Assist Hospital.

The Jovian Electric League, of Pittsburgh, Pa., at its weekly luncheon on May 23, took the initiative in raising a fund towards the "Tag Day" of the Childrens' Hospital. The members, and there was not a large attendance, raised $50 for the little cripples and sufferers.

Central-Station Power for Municipal Pumping.

This article points out the principal advantages of central-station power for municipal pumping, commenting on important pump and motor characteristics which should be considered when changing over to electric drive and presents comprehensive data on a large number of plants now operating satisfactorily.

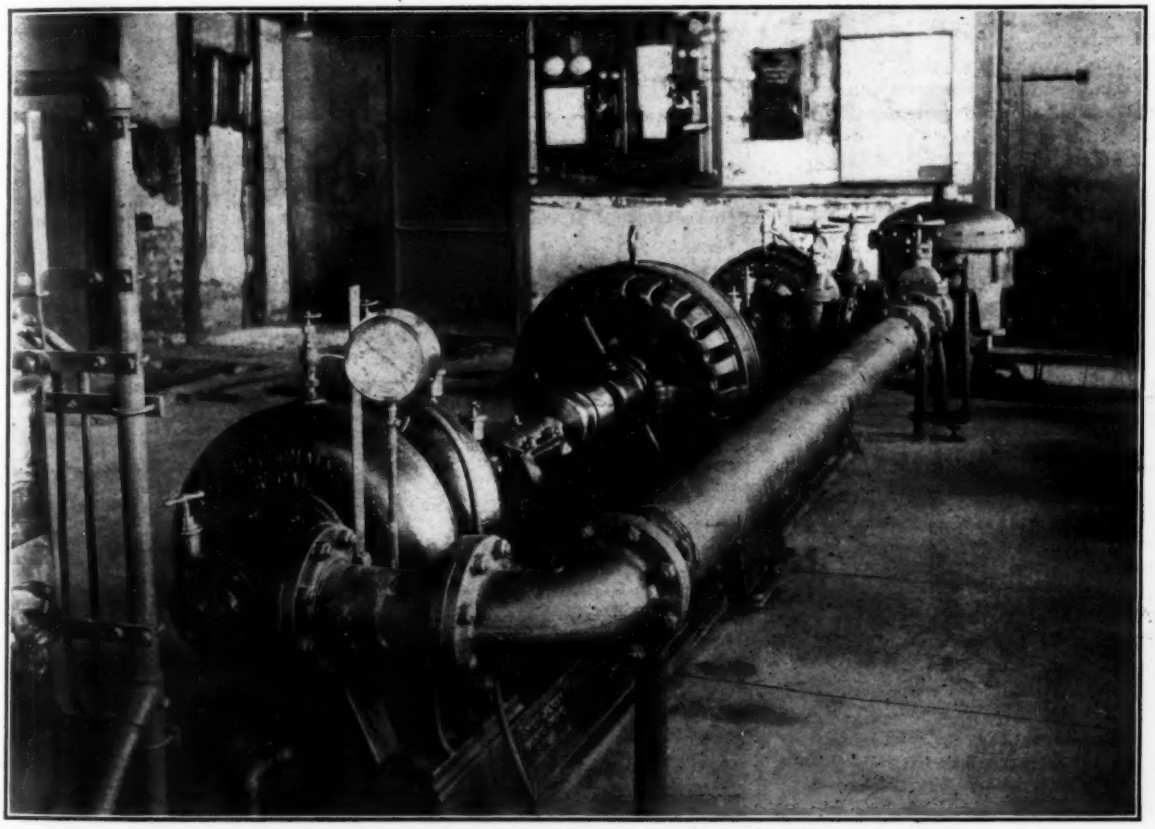
In looking over the field for new business most central-station companies do not give proper consideration to the subject of water-works pumping. Of the many reasons why the subject has not been given the serious effort which it deserves probably the foremost is that the central station, when not municipally operated, feels that the time and effort necessary to convince the municipality of the advantages of electric pumping are not worth the prospective business. It is true that, as a rule, the municipality is a difficult customer to obtain. Political situations must be overcome, as well as in many cases, a gross lack of knowledge of the true conditions surrounding the operation of the pumping plant by the municipality. The want of confidence in the ability of electric service to operate the pumping machinery without interruption has in the past been a strong objection for the central station to overcome.

The municipality should be shown, however, the saving it can effect through the purchase of energy developed under central-station conditions, as well as the lesser space and lower cost of maintenance of electrical installations.

Of course, the chief field for the possible use of electric power is in the main city pumping stations for the supply of water for drinking as well as other domestic purposes. This load offers a great many attractive features from the central-station man's point of view, chief of which is its "off-peak" characteristics.

Though it is an old story to those familiar with central-station practice, the securing of off-peak loads is one of the main elements of financial success. Consider a central station in a small city with a rated capacity of 1,000 kilowatts. If it were possible to operate such a plant continuously at rated load, that is, with 100 per cent load-factor, then the output for the year would be 8,760,000 kilowatt-hours. Probably, however, a load-factor of 20 per cent would come nearer the practical case, making the yearly output 1,752,000 kilowatt-hours, an average of 4,800 kilowatt-hours per day.

Make assumptions for this plant as follows: First cost—cost of plant at $100 a kilowatt, $100,000. Cost of distribution system, $100,000, making a total cost of $200,000. Yearly charges at 20 per cent load-factor with a yearly output of 1,750,000 would be: Fixed charges, $30,000; variable charges, $40,000, making a total of $70,000. This will then correspond to a cost of four cents a kilowatt-hour at the switchboard. Then if by adding paying load, whether off-peak or not, so long as the peak does not exceed the operating capacity, the load-factor could be increased to 40 per cent, the output would be doubled with an increase of say $30,000 in the operating expenses. This will then correspond



Harvey Water Works—50-Horsepower Motor Driving Two Centrifugal Pumps.

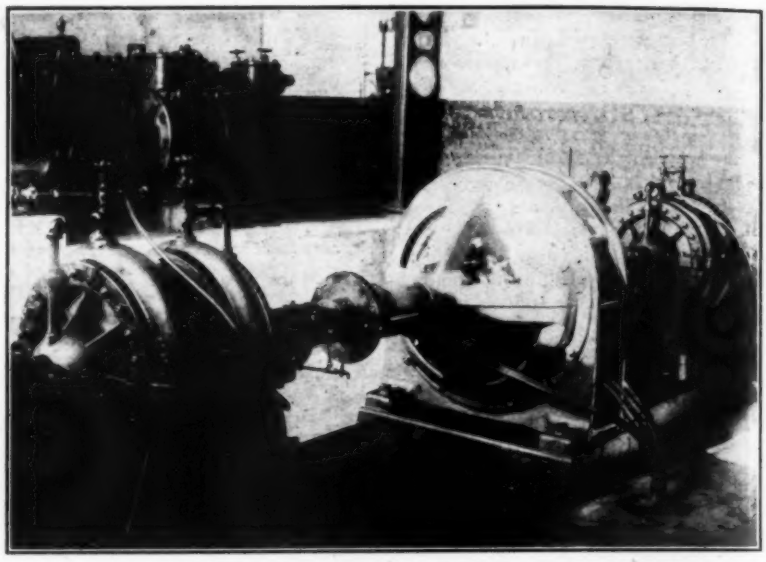
to a switchboard cost of 2.9 cents per kilowatt-hour.

If the average selling price per kilowatt-hour generated be 5 cents, the profits in the first case would amount to $17,500; and in the second case to $73,500. There is thus considerable margin for adjustment of rates to secure this profitable increase in load. If the increase is entirely off-peak, no increase in station capacity will generally be required, but it is interesting to note that up to the point where the operating capacity of the plant is reached by the maximum peak that the extra income is obtained at proportionally lower additional costs.

In a general way there are two kinds of water-works systems in use in this country, one a direct system where no reservoir capacity is provided, the rate of pumping varying directly as the demand for water, and the reservoir system, where a reservoir is provided so that water may be supplied after the pumps are shut down. Of the two systems, the most attractive and the easiest to get on a profitable basis is, of course, the reservoir system. With such a system the pumping can be very largely done at such times as best suits the load conditions of the central station and so can be made practically off-peak business. For such business the central station can offer very low rates and still make a profit.

In a direct system, of course, the reservoir feature is lacking and for this reason this pumping business does not offer so great an attraction for the central station. It must be remembered, however, that the greatest demands for water are during the months from April to October, when the demand for electric energy is least; and the demands for water are least from October to April, when the demand for energy is greatest. There is thus an annual diversity-factor offered, even in direct systems, which is most attractive. Practically all new systems being installed have the reservoir feature, so that there is an opportunity for the central stations of the country to secure most of this business as off-peak business. For the direct systems that are already installed, probably the best method of securing this business is by advocating a combined station, the old steam equipment to operate during peak months, etc., and motor-driven pumps to carry the summer peaks. This arrangement gives the central station a diversity-factor that should be most acceptable.

In many cities the suburbs are built upon hills that are often considerably above the city proper. In many cases the water pressure which is suitable for the main portion of the city is entirely too low for the suburbs, so that the pressure of the water furnished the suburb has to be boosted. Sometimes special high-pressure mains are provided for such suburbs, but a simpler way is by installing local motor-driven boosting stations in the suburb. In Duluth, Minn., an installation of this character has been made. This is business that the central station should have little difficulty in obtaining.

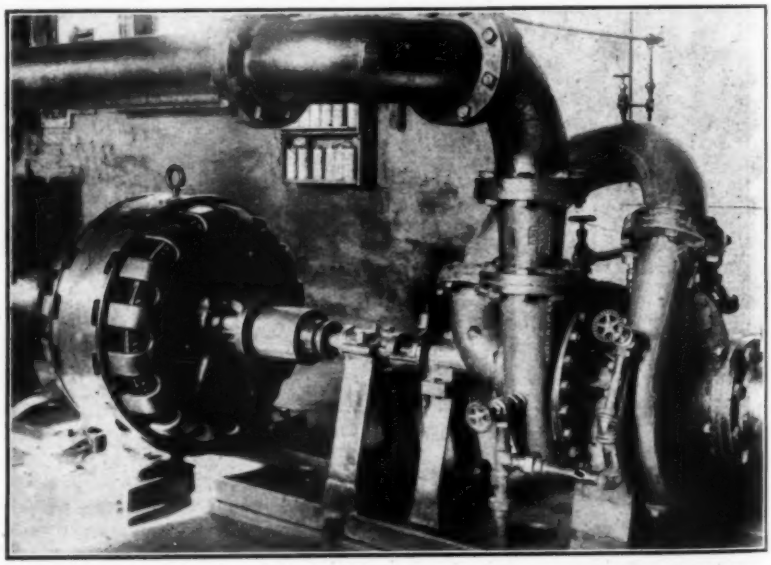


Oak Park Water Works—100-Horsepower Motor Driving Two Two-Stage Centrifugal Pumps.

Pump and Motor Characteristics.

Two types of pumps may be considered for driving by electric motors, the plunger type in its various forms and the centrifugal type in several forms differing only slightly. Usually the plunger type considered would be triplex and either single or double acting.

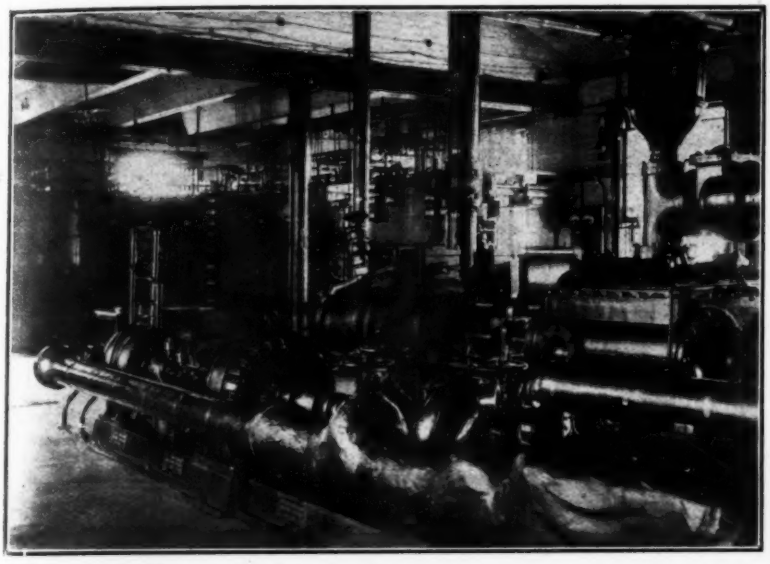
The plunger type has the advantage of being a little more efficient than the centrifugal, but it is essentially a low-speed machine, limited to thirty revolutions per minute or thereabouts. It therefore requires speed reduction, as by gearing for connection to driving motor, thus increasing cost and adding complexity.



Oak Park Water Works—100-Horsepower Motor Driving a Two-Stage Centrifugal Pump.

The centrifugal pump, on the other hand, is suitable for direct connection to motors operating at their normally high speeds, up to say 1,500 revolutions per minute. Such pumping units are low in first cost, compact and easily operat-

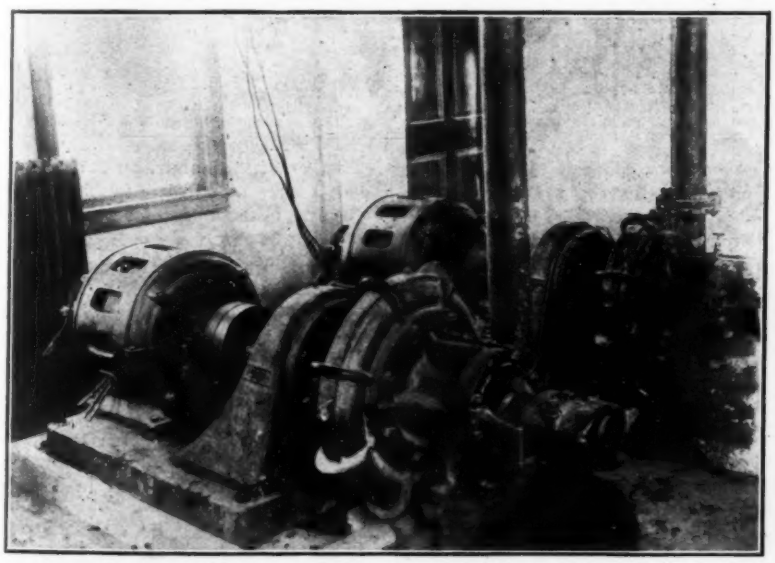
ed. Further, centrifugal pumps are suited to direct-pressure service, that is, they may be used to supply water direct to city mains without requiring a standpipe, which is not true of the plunger type, these requiring by-pass and relief valves as they are naturally constant-quantity pumps when driven by a constant-speed motor.



La Grange Water Works—100-Horsepower Motor Driving Two Two-Stage Centrifugal Pumps.

There have been many improvements in centrifugal pumps within the last few years, and standardized product can be obtained from the best manufacturers, with pump efficiencies of 60 to 70 per cent and over, even in small sizes, and with characteristics suited to direct-pressure service. Motor and pump should be mutually adapted, as there is possibility of danger of overloading the motor when pumping against too low a head. Reducing the head means working on the right-hand portion of the characteristic curve beyond normal rating when the quantity or discharge is greater.

Both types give reliable and satisfactory service under conditions to which they are essentially adaptable; they appear to be remarkably free from troubles, and expense for maintenance and repair is low.



Franklin Park Water Works—Two 20-Horsepower Motors Driving Two Single-Stage Centrifugal Pumps.

The opportunity for measuring power electrically is of advantage in analyzing costs and separating plant wastes.

In the large city pumping stations where the efficient or high-duty pumping units have held the field for years, it is possible that only some exceptional local condition will give the preference to electrically driven pumps; especially is this true since the advent of the steam-turbine-driven centrifugal.

At Duluth, two steam pumping units, each having a capacity of 5,000,000 gallons per 24 hours, were installed and it became necessary to enlarge the plant. The lowest bid on a 12,000,000-gallon steam pump was $90,000, as against the complete cost of $23,000 of the 13,000,000-gallon electrically driven centrifugal pump which was installed. The motor was 1,000 horsepower three-phase operating at 750 revolutions per minute on a 300-foot head, and the combined efficiency of pump, motor and transformers was 73 per cent. The cost of pumping by steam was $8.50 per million gallons and by electricity $6.50 per million gallons.

At Buffalo several years ago a 25,000,000-gallon pump was needed and at once. Bids showed cost of electric pump to be $30,000 and cost of steam $125,000. Electric was chosen, and a few months afterward a duplicate was ordered and later a third unit. Apparently first cost as well as low cost of power has influence upon the selection.

In the smaller plants where the inefficient duplex direct-acting steam pumps are in use, considerable improvement in economy can be secured by changing to electric pumping. Assume that the water supply necessary is 300 gallons per minute on the average, at a pressure of 60 pounds per square inch. The water horsepower will average about 10, and with ordinary direct-acting steam pumps the steam consumption will probably approach 150 pounds of steam per delivered horsepower-hour, whereas, an electrically driven centrifugal pump, with efficiency as low as 60 per cent, would require a motor input of 16 kilowatts, and the consumption of steam should not exceed 22 pounds of steam per horsepower-hour.

There has been considerable mystery about deep wells which is gradually dissipating as more wells are drilled. To compile reliable data on this subject the Engineering Experiment Station of the University of Illinois drilled a deep well over a year ago. This experimental deep well is 16 inches in diameter to a depth of 250 feet, and 8 inches in diameter below that to a total depth of 790 feet. Several water-bearing strata were encountered at various depths, but the main water-bearing strata appears at just above sea level.

The static water level was found to be 140 feet below the surface and the

pumping level receded gradually at the rate of 0.4 foot per gallon per minute pumpage.

After a year's use the static level has risen approximately 10 feet, the cause of which has not yet been definitely determined. The water levels were determined by test air pipe and gauge and later an electric device was used.

There are a number of methods of pumping deep wells; air lifts, single and double-piston lift pumps, and deep-well centrifugal pumps. For lifts of 180 to 200 feet, air lifts tested give efficiencies of less than 20 per cent. Naturally with lower lifts efficiency is higher. Professor Harris of the School of Mines, Rolla, Mo., has secured an efficiency of 25 per cent for a 250-foot lift.

In a crooked deep well hole of small diameter the air lift appears to be the only practicable method, but the extra cost of drilling a larger diameter of straight hole for the first 250 to 300 feet is by no means prohibitive.

The deep-well centrifugal pump is generally of considerable capacity and requires a large bore of well. There is usually one stage for each 50 feet of lift and a five-stage centrifugal for a lift of 250 feet would probably have an efficiency of about 40 per cent.

Power driven pump heads with single-piston and double-piston lift pumps have been used for many years for pumping deep wells. When operated by steam such lift pumps generally show low efficiency on account of slow speed and perhaps long lengths of steam pipe, whereas power heads driven by steam engine, gasoline engine and by electric motors show high efficiency. The motor-driven double-piston pump shows on test efficiencies in the neighborhood of 80 per cent from power input of pump to water horsepower, and efficiency of 70 per cent or more including motor.

The following comparison of power costs for double-piston lift pump, centrifugal deep-well pump, and straight air lift, each motor-driven, is of interest:

Pumping 250 gallons per minute, pumping level = 285 feet.

Type of pump.	Water horse-power.	Pump Efficiency per cent.	Kilowatts input to transformers.	Cost of power 8,000 hours at 3 cents per kilowatt-hour.
A—Double Piston	18	75	24	$ 5,760
B—Centrifugal	18	40	45	10,800
C—Straight Air	18	20	90	21,600

Static level = 185 feet.

Calculations which are simple but too long for presentation have proven that under the above conditions of well, the best pumping rate for double-piston pumps is in the neighborhood of 150 gallons per minute. Conditions which will largely influence choice of pumps for deep wells are time and money, cost of repairs and maintenance.

THEORETICAL HORSEPOWER TO RAISE WATER TO DIFFERENT HEIGHTS.

Gallons per Min.	Feet Elevation. 5	10	15	20	25	30	35	40	45	50	60
5	.006	.012	.019	.025	.031	.037	.044	.05	.06	.06	.07
10	.012	.025	.037	.050	.062	.075	.087	.10	.11	.12	.15
15	.019	.037	.056	.075	.094	.112	.131	.15	.17	.19	.22
20	.025	.050	.075	.100	.125	.150	.175	.20	.22	.25	.30
25	.031	.062	.093	.125	.156	.187	.219	.25	.28	.31	.37
30	.037	.075	.112	.150	.187	.225	.262	.30	.34	.37	.45
35	.043	.087	.131	.175	.219	.262	.306	.35	.39	.44	.52
40	.050	.100	.150	.200	.250	.300	.350	.40	.45	.50	.60
45	.056	.112	.168	.225	.281	.337	.394	.45	.51	.56	.67
50	.062	.125	.187	.250	.312	.375	.437	.50	.56	.62	.75
60	.075	.150	.225	.300	.375	.450	.525	.60	.67	.75	.90
75	.093	.187	.281	.375	.469	.562	.656	.75	.84	.94	1.12
90	.112	.225	.337	.450	.562	.675	.787	.90	1.01	1.12	1.35
100	.125	.250	.375	.500	.625	.750	.875	1.00	1.12	1.25	1.50
125	.156	.312	.469	.625	.781	.937	1.094	1.25	1.41	1.56	1.87
150	.187	.375	.562	.750	.937	1.125	1.312	1.50	1.69	1.87	2.25
175	.219	.437	.656	.875	1.093	1.312	1.531	1.75	1.97	2.19	2.62
200	.250	.500	.750	1.000	1.250	1.500	1.750	2.00	2.25	2.50	3.00
250	.312	.625	.937	1.250	1.562	1.875	2.187	2.50	2.81	3.12	3.75
300	.375	.750	1.125	1.500	1.875	2.250	2.625	3.00	3.37	3.75	4.50
350	.437	.875	1.312	1.750	2.187	2.625	3.062	3.50	3.94	4.37	5.25
400	.500	1.000	1.500	2.000	2.500	3.000	3.500	4.00	4.50	5.00	6.00
500	.625	1.250	1.875	2.500	3.125	3.750	4.375	5.00	5.62	6.25	7.50

Gallons per Min.	Feet Elevation. 75	90	100	125	150	175	200	250	300	350	400
5	.09	.11	.12	.16	.19	.22	.25	.31	.37	.44	.50
10	.19	.22	.25	.31	.37	.44	.50	.62	.75	.87	1.00
15	.28	.34	.37	.47	.56	.66	.75	.94	1.12	1.31	1.50
20	.37	.45	.50	.62	.75	.87	1.00	1.25	1.50	1.75	2.00
25	.47	.56	.62	.78	.94	1.09	1.25	1.56	1.87	2.19	2.50
30	.56	.67	.75	.94	1.12	1.31	1.50	1.87	2.25	2.62	3.00
35	.66	.79	.87	1.08	1.31	1.53	1.75	2.19	2.62	3.06	3.50
40	.75	.90	1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00
45	.84	1.01	1.12	1.41	1.69	1.97	2.25	2.81	3.37	3.94	4.50
50	.94	1.12	1.25	1.56	1.87	2.19	2.50	3.12	3.75	4.37	5.00
60	1.12	1.35	1.50	1.87	2.25	2.62	3.00	3.75	4.50	5.25	6.00
75	1.40	1.69	1.87	2.34	2.81	3.28	3.75	4.69	5.62	6.56	7.50
90	1.68	2.02	2.25	2.81	3.37	3.94	4.50	5.62	6.75	7.87	9.00
100	1.87	2.25	2.50	3.12	3.75	4.37	5.00	6.25	7.50	8.75	10.00
125	2.34	2.81	3.12	3.91	4.69	5.47	6.25	7.81	9.37	10.94	12.50
150	2.81	3.37	3.75	4.69	5.62	6.56	7.50	9.37	11.25	13.12	15.00
175	3.28	3.94	4.37	5.47	6.56	7.66	8.75	10.94	13.12	15.31	17.50
200	3.75	4.50	5.00	6.25	7.50	8.75	10.00	12.50	15.00	17.50	20.00
250	4.69	5.62	6.25	7.81	9.37	10.94	12.50	15.72	18.75	21.87	25.00
300	5.62	6.75	7.50	9.37	11.25	13.12	15.00	18.75	22.50	26.25	30.00
350	6.56	7.87	8.75	10.94	13.12	15.31	17.50	21.87	26.25	30.62	35.00
400	7.50	9.00	10.00	12.50	15.00	17.50	20.00	25.00	30.00	35.00	40.00
500	9.37	11.25	12.50	15.62	18.75	21.87	25.00	31.25	37.50	43.75	50.00

As to horsepower requirements for pumping water the accompanying table gives the theoretical horsepower required to raise water to different heights.

A close approximation of the actual horsepower required for 100-foot lifts is 1.7 times the theoretical; for 200-foot lifts, 1.45 times; and for 300-foot lift, 1.3 times, for triplex pumps; for deep-well pumps, double the theoretical power for safe estimates.

Combination Plants.

As previously mentioned, combination electric and pumping plants offer ideal means to both the central station and the municipality for increasing the load-factor in the one case and securing continuity of service and minimum rates for the latter. The probable existence of a diversity-factor between the two kinds of service suggests certain important economies at once. The following table has been prepared from monthly statistics of output from a pumping station and an electric station, each supplying the entire demands in a city of less than 20,000 inhabitants. Column 1 of the table gives the monthly outputs of water in percentages of the annual output and column 2 gives similar data for the electric output. Column 3 gives the monthly outputs on the assumption of a constant rate per day throughout the year. and serves as a basis for comparison

TABLE I.—MONTHLY OUTPUTS OF WATER AND ELECTRIC ENERGY IN PERCENTAGES OF ANNUAL OUTPUTS; AND MONTHLY PERCENTAGES OF ANNUAL PEAK LOAD.

	—Output by— Months. Water (1)	Electric (2)	Uniform Rate (3)	—Deviation— in output. Water (4)	Electric (5)	Monthly Electric Peak Load (6)
January	8.68	9.17	8.49	+0.19	+0.68	83
February	7.39	8.25	7.67	—0.28	+0.58	77
March	8.43	8.55	8.49	—0.06	+0.06	72
April	7.14	8.12	8.22	—1.08	—0.10	68
May	7.17	7.07	8.49	—1.32	—1.42	68
June	8.76	6.77	8.22	+0.54	—1.45	66
July	10.81	6.57	8.49	+2.32	—1.92	65
August	9.50	7.14	8.49	+1.01	—1.35	67
September	8.69	7.76	8.22	+0.47	—0.46	69
October	8.41	9.09	8.49	—0.08	+0.60	81
November	7.10	10.35	8.22	—1.12	+2.13	97
December	8.03	11.18	8.49	—0.46	+2.69	100

with the actual outputs. Column 4 gives the deviation of the percentages in column 1, for water, from those in column 3; or, in other words, it shows the monthly variation from a uniform rate of output. Column 5 shows the same thing for the electric output. The annual peak load on the electric station came in December and column 6 shows how the monthly peak loads compare with the annual peak, in per cent.

The annual peak of demand for water came in July, as compared with December for electricity; the lowest demand for water came in May, while the lowest peak demand for electricity came in July. In general the demand for electricity increased from July to December and fell from January to June, while the demand for water varied in the reverse manner, although there was some irregularity in April and May, followed by a rapid rise in June and July. The explanation of these conditions is almost obvious; the long lighting hours occur, of course, during the early winter season and the greatest demands for water, caused largely by sprinkling, occur during the summer. The demands for both kinds of service, however, are affected by weather conditions; if the summer rainfalls are heavy, the demands for sprinkling are correspondingly lessened. Dark weather, at any time of year, increases the lighting demands. These factors are rarely alike in consecutive years and in fact may not repeat themselves for a period of several or even many years. Table II shows statistics of output similar to Table I, for the same city, during the year next preceding. The variations of electric output and demand are quite similar to those in Table I, as might be expected from the fact that the variation in the length of a day (sunrise to sunset), during a whole year, is largely responsible for the variations of load. The maximum demand for water occurred in July and the minimum in February, with a very consistent change, month by month, from one extreme to the other. The year, as a whole, seems to show very normal conditions, quite consistent with the ordinary fluctuations of output and demand.

TABLE II.—MONTHLY OUTPUTS IN PER CENT FOR THE YEAR PRECEDING THE PERIOD OF TABLE I.

	—Output by— Months.			—Deviation— in output.		
	Water	Electric	Uniform Rate	Water	Electric	Electric Peak Loads
January	7.58	8.77	8.49	—0.91	+0.28	69
February ..	6.83	8.32	7.57	—0.84	+0.65	60
March	7.41	7.77	8.49	—1.08	—0.72	66
April	7.12	7.35	8.22	—1.10	—0.87	62
May	7.09	7.15	8.49	—1.40	—1.34	62
June	8.04	6.58	8.22	—0.18	—1.64	59
July	9.85	6.78	8.49	+1.36	—1.71	60
August 10.54		7.36	8.49	+2.05	—1.13	69
September ..10.20		7.95	8.22	+1.98	—0.27	79
October	8.65	10.21	8.49	+0.16	+1.72	85
November ..	8.19	10.26	8.22	—0.03	+2.04	97
December ..	8.54	11.45	8.49	+0.05	+2.96	100

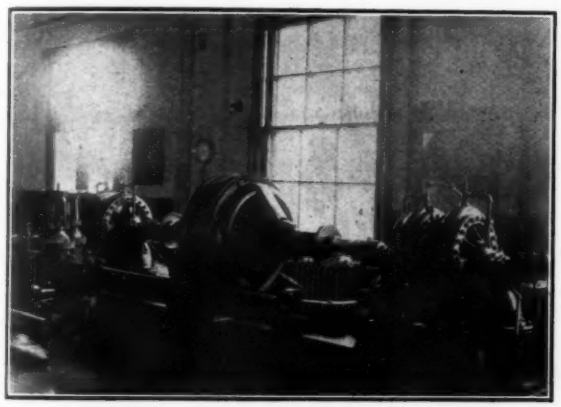
Table III shows similar statistics for the second year preceding that of Table I. It shows nothing new in regard to the electric output, but it is notable that in each year the annual peak load came in December, while the lowest monthly peak came in July in two instances and in June in the other instance. The latter averages about 65 per cent of the December peak. The output of water shows rather unusual conditions; the lowest outputs were in December and January; but there was a marked decrease from ordinary conditions during June, July and August and some increase during October. This points to a summer season of unusually large rainfall and perhaps some deficiency during October. While this may explain the results in part, or perhaps wholly, it should be kept in mind that much water is consumed by industrial concerns; and naturally the general activity among the industries will be a factor and will reflect itself in the gross output.

TABLE III.—MONTHLY OUTPUTS IN PER CENT FOR THE SECOND YEAR PRECEDING THE PERIOD OF TABLE I.

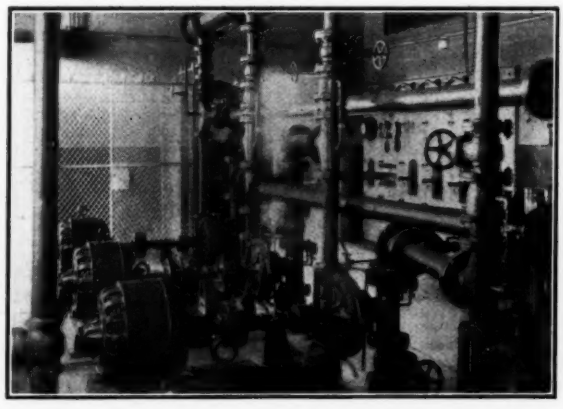
	—Output by— Months.			—Deviation— in output.		
	Water	Electric	Uniform Rate	Water	Electric	Electric Peak Loads
January	7.48	10.13	8.49	—1.01	+1.64	96
February ...	7.76	8.15	7.67	+0.09	+0.48	84
March	8.79	8.56	8.49	+0.30	+0.07	79
April	8.80	8.46	8.22	+0.58	+0.24	79
May	9.25	8.12	8.49	+0.76	—0.37	74
June	8.08	7.29	8.22	—0.14	—0.93	72
July	8.59	7.24	8.49	+0.10	—1.25	70
August	6.97	6.94	8.49	—1.52	—1.55	81
September ..	8.98	7.58	8.22	+0.76	—0.64	84
October	9.45	9.26	8.49	+0.96	+0.77	97
November ..	8.51	9.16	8.22	+0.29	+0.94	97
December ..	7.35	9.11	8.49	—1.14	+0.62	100

There have been instances where the winter demand for water approached the yearly maximum, caused by waste to prevent freezing in very cold weather. This condition is not a serious factor, however, when the distribution system is properly planned and where house-piping systems are installed with care. The waste in any case is greatly minimized by a meter system of charging. The monthly variations of demand, compared for different cities, do not show identical characteristics, particularly in the case of some of the larger cities. In the smaller cities, where consolidated water and electric plants are more common and productive perhaps of greater relative economy, the demands in many cases rise and fall inversely with the electric demands, as a whole.

Summing up these comparisons, it is apparent that there is great probability of a diversity-factor between the annual peak demands for the two kinds of service; and in many cases this probability is a practical certainty. There seems to be a sufficient degree of certainty to warrant the expectation that in the matter of primary power produc-



La Grange Water Works—100-Horsepower Motor Driving Two Centrifugal Pumps.



River Forest Water Works—Four 20-Horsepower Motors Driving Four Single-Stage Centrifugal Pumps.

tion, for pumping water and generating electrical energy, a combined plant will require a smaller installation than separate or independent plants. In steam-driven stations this joint use of installation would include the boiler plant, in any case; and it would extend further, to the engines (or turbines) and generators, in case electrically driven pumps prove to be the most economical under the conditions.

The maximum station demands for power from the prime movers differ widely, as a rule, for the two kinds of service, when supplying the same territory and population. The power required for pumping will ordinarily be a small fraction of the power output of the electric-station prime movers, assuming a normal development of both classes of service. This fraction will range in most cases between ten per cent and twenty per cent as extremes. This means that in the case of electrically driven pumps, the power required for pumping at the time of summer peak load on the electric station would not increase the peak to its December value. During the winter season the electric peak would be increased somewhat, of course, by the simultaneous demands for pumping.

But water service is essentially different from electric service in one very important particular; namely, water is a storable commodity and under many conditions can be economically stored in sufficient quantities to supply the system, without pumping, for a considerable period. In this respect then, a pumping load forms one of the most desirable classes of service which a central station can secure, that is, off-peak business. This class of business helps to improve the load-factor materially and reduces the unit cost of production. It is quite evident that a pumping load will increase the annual load-factor of a central station, from the previous consideration of monthly variations of demand.

Pumping Data.

Some interesting data on electric pumping have been submitted by the Great Northern Power Company of Duluth, Minn. This company supplies the city of Duluth with electrical energy for pumping water from Lake Superior for all public purposes. The equipment at the Lakewood pumping station comprises an I. P. Morris two-stage centrifugal pump driven by a 1,000-horsepower three-phase 750-revolutions-per-minute squirrel-cage motor. The pump has a 20-inch discharge and is capable of delivering 13,000,000 gallons per day of 24 hours against a head of 300 feet, and actually pumps against a head of 290 feet including suction.

The rates for this pumping are $6.50 per 1,000,000 gallons when the daily gallons pumped are 6,000,000 or less, $6.40 when 7,000,000 and so on by 10-cent steps per million gallons until $5.50 per million gallons is reached, when the rate remains stationary at that figure. At the present time there are about 7,000,000 gallons pumped per day. The contract also provides that the city is to pump during 18 hours of the day, the time being specified by the company, so the load is kept entirely off-peak and most of the pumping is done at night.

The accompanying Table IV gives the detailed figures of operation of the Lakeside station.

In addition to this pumping, the Great Northern Power Company is supplying power to the City of Duluth for a booster pump at the western end of the city, for filling a city reservoir at that point. Table V gives the operating figures for one year.

The pump at this plant is a Fairbanks-Morse centrifugal, single-stage, with an eight-inch discharge and driven by a 30-horsepower Fairbanks-Morse, three-phase, 440-volt induction motor. Water is delivered to this pump at pressure varying from 80 to 120 pounds and is pumped into the reservoir at a pressure of about 125 pounds, and all this pumping is done after 10:00 p. m. Current for pumping is delivered at 13,000 volts, three-phase, 25 cycles and the city provides the step-down transformers, lightning arresters, control apparatus, etc.

Commenting on this business, J. B. Crane, commercial engineer of the company, says:

"The kilowatt-hour rate for such pumping is necessarily very low on account of the fact that steam-driven pumps are very efficient and as the load-factor is high, the cost of pumping by steam is very little above the figures given for pumping by electricity.

"Inasmuch, as we are able to control the time of pumping we feel that these contracts are favorable to the Power Company but represent very nearly the maximum rate that can be obtained for this class of service."

TABLE IV.—PUMPING WATER—LAKEWOOD.

Month	Gallons Pumped	Kilowatt-hour	Expenditures. Electricity	Labor	Coal Oil & Supplies	Repairs	Totals
January	210,970,000	322,573	$ 1,276.05	$ 407.50	$ 6.15	$ 0.00	$ 1,689.70
February	186,700,000	285,464	1,350.21	425.00	439.15	.00	2,214.36
March	214,528,000	245,412	1,204.88	625.80	164.21	10.53	2,005.42
April	214,010,000	327,221	1,053.28	385.00	464.92	103.19	2,006.39
May	211,265,000	323,024	1,358.26	375.00	36.86	66.32	1,836.44
June	201,715,000	362,880	1,362.10	379.33	19.30	6.19	1,766.02
July	233,945,000	385,920	1,290.98	375.00	23.52	21.17	1,710.67
August	230,755,000	384,480	1,473.85	375.00	.25	.00	1,849.10
September	207,760,000	328,464	1,453.76	414.35	35.01	15.50	1,918.62
October	209,405,000	329,760	1,323.97	398.21	24.98	1.60	1,748.76
November	198,568,000	316,800	1,340.19	407.50	32.16	.00	1,779.85
December	200,710,000	318,240	1,269.70	412.75	30.50	26.82	1,739.77
Total	2,520,331,000	3,930,238	$15,757.23	$4,980.44	$1,277.01	$251.32	$22,266.00

TABLE V.—PUMPING WATER AT WEST DULUTH.

Month.	Gallons Pumped	Kilowatt-Hours	Expenditures Electricity	Labor	Sup.	Repairs	Totals
January	20,940,000	9,436	$74.94	$70.00	$0.60	$0.00	$145.54
February	16,620,000	7,980	78.70	70.00	13.25	17.25	179.20
March	26,460,000	12,180	75.35	80.00	0.00	0.00	155.35
April	32,460,000	14,940	85.01	70.00	.00	.00	155.01
May	35,040,000	16,632	91.36	108.00	.00	.00	199.36
June	32,280,000	11,640	95.25	130.00	.00	.00	225.25
July	37,920,000	15,726	83.77	118.38	.85	.00	203.00
August	43,440,000	21,360	93.16	132.20	.00	1.40	226.76
September	30,810,000	15,000	106.13	118.00	14.81	.00	238.94
October	26,100,000	12,120	91.50	82.60	.00	.00	174.10
November	24,360,000	11,520	84.88	83.60	.00	.00	168.48
December	16,740,000	8,040	83.50	70.00	.00	.00	153.50
Total	343,170,000	156,568	$1,043.55	$1,132.78	$29.51	$18.65	$2,224.49

A representative small municipality served with energy by the Public Service Company for pumping service is Edison Park, Ill. The population of this town is 543. Water is pumped from one well directly into the mains and stand-pipe by one American Well Works plunger pump, (3.5-inch bore, 24-inch stroke), having a capacity of 50 gallons per minute, driven by a four-horsepower single-phase motor. The average kilowatt-hours consumed per month equals 650 and the electrical energy consumption per 1,000 gallons pumped 0.6 kilowatt-hours. The total number of gallons pumped per month is 108,000.

Another small customer is Steger, Ill., the population of this town being 2,160. Here water is also pumped from a well directly into a stand-pipe, the latter having a capacity of 100,000 gallons. The equipment comprises an American Well Works 8.5-inch diameter plunger pump of 240-gallons-per-minute capacity geared to a 25-horse-

The Public Service Company of Northern Illinois, operating in a number of suburban towns adjacent to Chicago, has made great strides in supplying municipalities with electrical energy for water pumping, at present having 14 customers for this service. The company makes a flat rate of four cents per kilowatt-hour with the stipulation that all pumping be done during off-peak hours.

power three-phase, 60-cycle, 220-volt induction motor. The average monthly consumption is 464 kilowatt-hours; the average amount of water pumped, 774,000 gallons per month and the electrical energy consumption per 1,000 gallons pumped 0.6 kilowatt-hours.

At Crete, Ill., having a population of 841, water is pumped from a well into a stand-pipe by means of a Gould's 24-inch stroke, plunger pump belted direct to a 10-horsepower single-phase, 60-cycle, 208-volt motor, running at 1,800 revolutions per minute. The average monthly consumption is 92 kilowatt-hours and tests have shown the electrical energy consumption per 1,000 gallons pumped to be 0.6 kilowatt hours, also. Detailed data on a number of other plants supplied with energy by the Public Service Company are given in the accompanying data sheets.

For the small town it is often found advantageous to have the central-station company control and operate the entire water system. Under these conditions it is generally conceded that the most nearly ideal plant, one wherein the greatest number of safeguards against a possible failure to deliver service when demanded can be maintained, and at the same time where the highest efficiency in pumping may be secured at the smallest cost, would be one having steam pumps, held in reserve, a motor-driven pump just large enough to take care of ordinary domestic service and the central-station plant, all contained in one building.

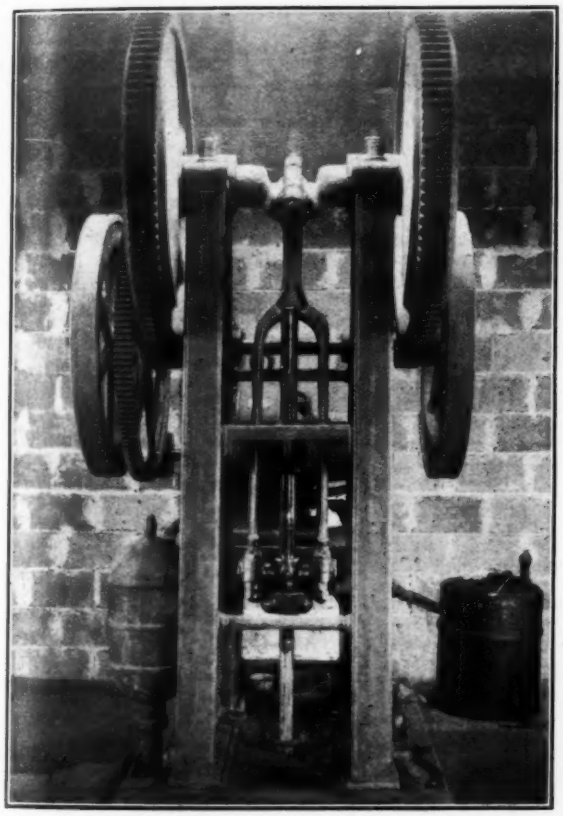
Such a station is in Lincoln, Ill. The pumping equipment consists of a gearless upright duplex plunger pump having a capacity of 1,250,000 gallons per 24 hours, which is belted to a 75 horsepower, 60-cycle, three-phase, 2,300-volt induction motor; two compound double-acting steam pumps, each of 1,250,000 gallons capacity; a battery of four boilers, the boiler nearest the steam pumps being so arranged that it can be disconnected from the other boilers and steam header, and used to operate the steam pumps entirely independent of the electric portion of the station. It is doubtful if any situation might arise, which would prevent the pumping of water, excepting a boiler explosion, wrecking the entire station.

A stand-pipe is used which is equipped with a check valve opening outward. Around this check a by-pass is constructed, the opening of which may be regulated by moving a lever. Ordinarily the by-pass opening is equal to one 2.5-inch fire hydrant nozzle.

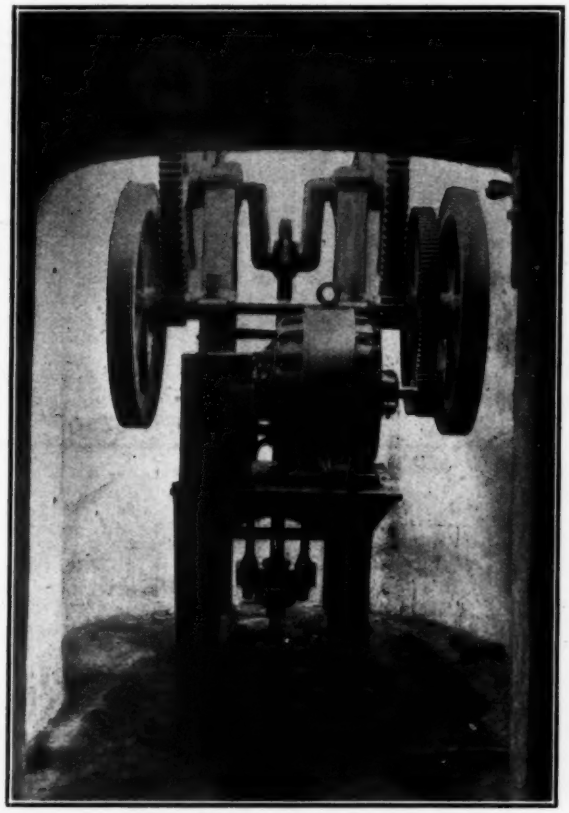
The motor-driven pump being constant speed, it is arranged to pump the average daily consumption of water in 13 hours, the excess water being forced into the stand-pipe (which has a capacity of 150,000 gallons) and is stored for use when the pump is idle. The pump is usually operated between the hours of 1 to 4 and 6 to 9 a. m., and 1 to 6 and 9 to 11 p. m.

When a fire occurs this pump is started, if at the time it is idle, or simply allowed to run at its constant speed if it happens to be in use, one of the reserve steam pumps is started or both if needed, and the pressure is regulated at about 110 pounds for fire, the pressure carried for domestic use being 60 pounds. With this arrangement a fire pressure can be raised within 2 minutes time, whether the motor driven pump is idle or not at the time an alarm is given.

It has been found by tests that this motor-driven pump will operate with 6,374 pounds less coal per million gallons pumped than will either of the steam pumps (the coal used being a very dirty grade of slack) and it requires an average of 444 kilowatt-hours per million gallons of water pumped. No extra labor is needed because of the pumping of water, for the regular force of station employees can handle it very nicely.



Homewood Water Works—20-Horsepower Motor Geared to Plunger Pump.



Franklin Park Water Works—15-Horsepower Motor Geared to Plunger Pump.

Pumping Data—Sheet No. 1.

The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.

Minot City Water Pumping Plant, Minot, N. D. Population, 4,125. Individual drive. Running hours per week varies.

Total connected horsepower, 246.5. Number of motors installed, 11. Average kilowatt-hours per month, 13,490. Average kilowatt-hours per month per horsepower connected, 54.

Kilowatt-hour consumption for 8 months: January, 10,700; June, 15,230; July, 13,090; August, 17,700; September, 16,100; October, 12,200; November, 12,000; December, 10,900.

Load-factor, 10 per cent.

Size of city reservoir is 100,000 gallons. Average monthly supply of water pumped, 9,365,649 gallons.

Average number of gallons pumped per kilowatt-hour, 694.

Average number of gallons used per day, 312,188.

Average kilowatt-hour consumption per 1,000,000 gallons, 1,440.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts.

No.	Horse-power.	Speed R. P. M.	Application.
2	100	690	Each geared direct to two 10 by 12-inch horizontal, duplex, outside-center-packed plunger-type pumps, manufactured by Fairbanks, Morse & Co. Capacity, 700 gallons per minute against 375-foot head at 45 revolutions per minute.
2	7.5	1200	Each direct-connected to centrifugal pumps, capacity of each 750,000 gallons daily. Manufactured by Lawrence Pump & Engine Co These pumps are used for pumping water from river into forebay.
1	20	900	Direct-connected to one centrifugal pump, capacity 1,500 gallons per minute; manufactured by Lawrence Pump & Engine Co. This pump is used only for washing the filter beds, which under ordinary conditions is not done oftener than once per day, requiring about one hour.
1	7.5	1,200	Geared direct to one 12 by 8-inch duplex air compressor. The discharge of this compressor is into the main air line which has connection into the air system of each filtering bed.
4	0.5	1,800	Each direct-connected to one chemical mixer.
1	2	1,800	Direct-connected to one agitator.

This pumping station is arranged in duplicate in case of breakdown or emergency. Energy is supplied by the Minot Light & Telephone Company.

El Reno Water Company, El Reno, Okla. Population, 7,872. Individual drive. Running hours per week, 144.

Total connected horsepower, 115. Number of motors installed, 4. Average kilowatt-hours per month, 12,806. Average kilowatt-hours per month, per connected horsepower, 111.

Kilowatt-hour consumption for 9 months: April, 14,260; May, 10,890; June, 10,770; July, 10,390; August, 17,184; September, 14,180; October, 10,480; November, 11,920; December, 15,180.

Load-factor, 20.4 per cent; operating-time load-factor, 23.8 per cent.

The average electrical energy consumption per 1,000 gallons of water pumped is 1.06 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is two-phase, 60 cycles, 220 volts.

No.	Horse-power.	Speed R. P. M.	Application.
1	40	1,200	Direct-connected to one 10 by 12-inch Deane pump, capacity 204 gallons per minute at 25 strokes.
1	40	1,800	Direct-connected to one five-inch three-stage centrifugal pump, capacity 500 gallons per minute at 225-foot head.
1	20	900	Direct-connected to one 7 by 8-inch Deane triplex pump, capacity 180 gallons per minute at 45 strokes.
1	15	1,800	Direct-connected to pump, pumping from six wells, 80,000 to 100,000 gallons per day.

Energy is supplied by the El Reno Gas & Electric Company.

North Crystal Lake Water Works, North Crystal Lake, Ill. Population, 1,931. The water is pumped from one well directly into the mains and stand pipe.

One 20-horsepower induction motor is installed. Average monthly kilowatt-hour consumption is 1,512.

Load-factor, 14 per cent.

Average number of gallons pumped per capita per day, 40.6. Gallons pumped per month, 2,358,000.

Average electrical energy consumption per 1,000 gallons pumped, 0.6 kilowatt-hours.

MOTOR INSTALLATION.

The motor installed in this plant is a three-phase, 60-cycle, 220-volt induction machine.

No.	Horse-power.	Speed R. P. M.	Application.
1	20	860	Direct-connected to one Keystone Driller Company's plunger pump. Pump head 34 feet; rods 2.5 inches; working barrel 7.75 inches. Capacity 260 gallons per minute.

Energy is supplied by the Public Service Company of Northern Illinois.

Pumping Data—Sheet No. 2

La Grange Water Works, La Grange, Ill. Population, 10,500. Individual drive. Running hours varies. Water is obtained from three deep wells.

Total connected horsepower, 275. Number of motors installed, 5. Average kilowatt-hours per month, 32,029.

Load-factor, 21.3 per cent.

Number of gallons pumped per capita per day, 57.8. Total number of gallons pumped per month, 18,005,054.

The average electrical energy consumption per 1,000 gallons pumped is 1.78.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drive. The supply source is three-phase, 60 cycles, 440 volts.

No.	Horse-power.	Speed R. P. M.	Application.
2	25	...	Each direct-connected to a Byron Jackson deep-well pump, each pump having a capacity of 350 gallons per minute against 100-foot head.
1	75	900	Direct-connected to one American Well Works deep-well pump, having a capacity 1,000 gallons per minute against 80-foot head. These deep-well pumps discharge into a reservoir beneath the pumping station and from here the water is pumped into stand pipe.
1	100	1,200	Direct-connected to two two-stage American Well Works centrifugal service pumps, having a combined capacity of 1,500 gallons per minute against 60-pounds pressure.
1	50	1,120	Direct-connected to two two-stage Byron Jackson centrifugal service pumps, having a combined capacity of 700 gallons per minute against a 138-foot head. These pumps can be connected in series or any one pump can be disconnected by means of clutches.

Energy is supplied by the Public Service Company of Northern Illinois.

Harvey Water Works, Harvey, Ill. Population, 7,200. Individual drive. Water is obtained from three deep wells by means of both air-lift and deep-well pumps. The wells discharge into an open reservoir and from this the water is pumped into a stand pipe.

Total connected horsepower, 450. Number of motors installed, 5. Average kilowatt-hours per month, 41,847.

Load-factor, 17 per cent.

Number of gallons pumped per capita per day, 66. Average number of gallons pumped per month, 13,801,-274.

The average electrical energy consumption per 1,000 gallons pumped is 3.03 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 440 volts.

No.	Horse-power.	Speed R. P. M.	Application.
1	200	600	Belted direct to one Ingersoll-Rand Imperial, type 10, two-stage air compressor which compresses about 950 cubic feet of free air per minute to 120 pounds gauge pressure.
2	50	1,120	Direct-connected to two Byron Jackson deep-well pumps with capacities of 400 gallons per minute against 120-foot head.
1	100	...	Direct-connected to two American Well Works two-stage centrifugal pumps, having a combined capacity of 1,500 gallons per minute against 60-pounds pressure.
1	50	1,120	Direct-connected to two Byron Jackson two-stage centrifugal pumps, having a combined capacity of 700 gallons per minute against a 138-foot head. The pumps can be connected in series to raise the pressure or any one can be disconnected by means of clutches.

Energy is supplied by the Public Service Company of Northern Illinois.

River Forest Water Works, River Forest, Ill. Population, 2,456. The water is obtained from deep wells by means of air lift and discharged into a covered reservoir from which it is pumped into a stand-pipe.

Total connected horsepower, 160. Number of motors installed, 6. Average kilowatt-hours per month, 13,330.

Load-factor, 15.2 per cent.

Number of gallons pumped per capita per day, 114.

Electrical energy consumption per 1,000 gallons of water pumped, 1.6.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 200 volts.

No.	Horse-power	Speed R. P. M.	Application.
2	40	690	Each belted direct to two Platt Iron Works 14 by 12-inch air compressors.
4	20	1,700	Each direct-connected to an American Well Works single-stage, three-inch centrifugal pump. These pumps can be connected in series to increase pressure if desired.

Energy is supplied by the Public Service Company of Northern Illinois.

Pumping Data—Sheet No. 3

Park Ridge Water Works, Park Ridge, Ill. Population, 2,000. The water is pumped from two wells directly into the mains and stand-pipe. Head approximately 120 feet.

Total connected horsepower, 40. Number of motors installed, 2. Average kilowatt-hour consumption per month, 2,091.

Load-factor, 9.5.

Number of gallons pumped per capita per day, 54. Total average number of gallons pumped per month, 3,241,500. Cost per 1,000 gallons pumped, 2.41 cents.

The average electrical energy consumed per 1,000 gallons pumped, 0.613 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 200 volts.

No.	Horse-power	Speed R. P. M.	Application.
1	20	..	Belted direct to one American Well Works plunger pump, 8-inch diameter by 24-inch stroke; capacity 300 gallons per minute.
1	20	..	Belted direct to one A. D. Cook plunger pump, 8-inch diameter by 18-inch stroke; capacity 300 gallons per minute.

Energy for this installation is supplied by the Public Service Company of Northern Illinois.

Oak Park, Ill. Population, 19,500. Individual drive. Running hours varies.

Water is obtained from six deep wells by means of air lift. The wells are 1,600 feet deep and it is from 113 feet to 163 feet below ground to the water level in the wells. The discharge from the deep wells flows into an open reservoir from which it is pumped into the stand pipe and mains.

Total connected horsepower, 400. Number of motors installed, 3. Average kilowatt-hours per month, 131,597.

Load-factor, 60.4 per cent.

Number of gallons pumped per capita per day, 70. Average number of gallons pumped per month, 37,059,148.

Electrical energy consumption per 1,000 gallons pumped, 3.55 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 440 volts.

No.	Horse-power.	Speed R. P. M	Application.
1	200	600	Belted to an Ingersoll-Rand, Imperial type two-stage air compressor. Compresses about 950 cubic feet of free air per minute to 120 pounds gauge pressure.
1	100	...	Direct-connected to two two-stage American Well Works centrifugal pumps, with a combined capacity of 1,500 gallons per minute against 60 pounds pressure.
1	100	..	Direct-connected to two two-stage American Well Works centrifugal pumps with a combined capacity of 750 gallons per minute against 60 pounds pressure. All these pumps can be connected in series to increase pressure for fire or otherwise and any pump can be disconnected from the motor by means of clutches.

Energy is supplied by the Public Service Company of Northern Illinois.

Greentree Pumping Station, Pittsburgh, Pa. This station is used to raise water supplied from the city mains to a tank located on one of the hills nearby and high enough to deliver water to the surrounding district at a proper pressure. Individual drive.

Running hours per week, 56 (approximately).

Total connected horsepower, 150. Number of motors installed, 2. Average kilowatt-hours per month, 4,168.

Kilowatt-hour consumption per month for 12 months with the corresponding number of gallons pumped:

Month	Kilowatt-hours	Gallons	Month	Kilowatt-hours	Gallons	Month	Kilowatt-hours	Gallons
February	3,460	6,116,168	June	4,000	6,805,113	October	4,050	6,849,336
March	3,875	6,578,907	July	4,565	7,790,033	November	3,700	6,269,474
April	3,750	6,339,273	August	4,980	8,542,745	December	4,375	7,237,677
May	3,850	6,530,870	September	4,640	7,767,577	January	4,595	7,572,271

The average head the water is pumped against is 240 feet.

Load-factor, 10.2 per cent; operating-time load-factor, 18 per cent.

The average electrical consumption per 1,000 gallons of water pumped is 0.592 kilowatt-hours.

MOTOR INSTALLATION.

The equipment in this plant is in duplicate. One pump is sufficient to take care of the water supply. The supply source is two-phase, 60 cycles, 2,200 volts.

No.	Horse-power.	Speed R. P. M.	Application.
2	75	720	Induction motors each geared to a Gould triplex power pump. The displacement of each pump is 15.14 gallons per revolution, (600 gallons per minute); speed 40 revolutions per minute; size of plungers 11.125-inch diameter by 12-inch stroke.

The station is maintained by the city.

Commercial Practice
Management, Rates, New Business

THE AVAILABILITY AND ADAPTABILITY OF ELECTRIC VEHICLES.[1]

By W. P. Kennedy.

It may well be conceded that after ten years' successful employment in economic service the electric vehicle has ceased to be an experiment and is as well developed as most of the industrial apparatus which we are at present using in commercial life as absolute necessities to present day conditions. We may be well convinced of this when we consider that the electric vehicle, particularly in its industrial application, is nothing more than a modification of the electric street car having the same engineering foundation for its design and production.

With the practical example of nearly 5,000 commercial vehicles and over 15,000 pleasure vehicles in successful employment there is today considerable wonder that they are not more universally employed, and the conditions tending to obstruct their almost universal application are well worth studying with the object of eradicating whatever impediment there may be and giving such impetus and propagation to their use as to establish in the minds of prospective machine users unquestionable confidence and an inclination to substitute them for the present or existing horse methods with the remarkable reduction in operating expense.

That progress towards their general use is not more active is further accentuated when we consider the four large and powerful influences at work in co-operation to stimulate their employment. These are the makers of the complete vehicles, the manufacturers of the accessory electrical apparatus required in their equipment and of storage batteries, and the public-service companies furnishing current.

A general inspection of the progress made so far shows that up to September 1, 1911, there had been put into service over $10,000,000 worth of commercial cars, $30,000,000 worth of pleasure vehicles and 30 per cent of this total was put into service in the 12 months preceding this date. This latter year's equipment included 1,000 commercial vehicles and 5,000 pleasure vehicles, amounting in value to $12,500,000. From the three months between December 1, 1911, and March 1, 1912, indications are that last year's business will be exceeded by 50 per cent, or in other words by September 1, 1912, we are safe in asserting there will be in use nearly $60,000,000 worth of this class of apparatus. Incidentally, the total annual current consumption for this equipment will be over 65,000,000 kilowatt-hours, and if this latter may be valued at four cents it would represent $2,600,000 annual revenue to electricity supply companies if it were possible to serve this entire equipment from central stations.

A peculiar feature of the increasing business, however, is the fact, generally admitted, that for the past two years nearly 70 per cent of the commercial vehicles placed in service was purchased by firms already using electric trucks, so that the gain in new business secured by manufacturers represents only about 30 per cent of their total output.

This indicates two things, which are somewhat difficult to reconcile. One is that this type of machine is so economically successful as to warrant continual increase in the equipment already in use, and the other contrasting feature is that notwithstanding this convincing example to the industrial and mercantile community it does not create a proportionate desire on their part to avail themselves of this economic apparatus.

Notable among the recent increase of established installations has been the addition within a few months of about 200 machines to the brewing industry and 200 machines to the express business, with the expected addition within the next six months of 200 more machines to the brewing business and 500 machines to the express line. This indicates that those organizations in which transportation is a serious and important part of their daily business, have recognized the utility and economy of the electrics and are superseding as fast as they practically can their existing horse equipments.

The more we encourage the public habit of using electric vehicles or electrical service in any form the more we stimulate the general interest with corresponding reflex individual benefit to its various other divisions. The present impediment to progress in this direction is a lack of familiarity with the real simplicity of the problem. There is an inclination to surround electric-vehicle employment with a good deal of unwarranted mystery and to lay stress on minor non-essential items, which may happen to be questionable at the moment, instead of looking broadly at the conspicuous advantages which machine users possesses.

A serious consideration before us, as sober-minded sponsors of the transition taking place, is whether the introduction of machines is being accomplished with such active efficiency as to stimulate rapid increase towards their universal employment, or have the present or prospective users entirely shaken off their inherited customs and conservative prejudices in favor of what they have been used to as against the advantages to be derived from a different practice.

Among the greatest difficulties which we encounter in this work is an almost complete absence of knowledge on the part of the users of horse service as to the cost of their transportation except in the few cases where the service is hired or transportation is the principal part of their business. Until the advocates of electric vehicles attempted to make the substitution of machines for horses on an economic basis it is a fact that reliable horse-transportation costs were unknown to the average merchant. The necessity for this information is being now recognized by them and they are gradually informing themselves, although the subject is handled in a very crude way by the majority.

It has been astonishing to most of us to discover the resentment which exists on the part of the merchant to consideration of the details of his wagon-service department. He has been accustomed in the past to delegate this to some minor subordiate and entirely forget it himself so that when we bring up the subject and he has to face the music of hearing his actual cost and the saving which might be made by the employment of electric vehicles we usually find him in an irritated attitude.

[1] Paper read at lunch of New England Section, N. E. L. A.

Again, even where we find the prospective user inclined to favorably consider machines we discover a strong disinclination to change the method which has been convenient with the use of horses, to any new scheme of operation which may be necessary to utilize the capacity of the machine.

There are also existing obstacles at loading and unloading points which are great causes of waste in any system, present or future, and which must be eradicated before long, even independent of the use of motor vehicles.

Last, but not least, we are confronted with a prevalent suspicion on the part of purchasing executives that the presentation made to them regarding the economy of electric vehicles is too good to be true. They have been so accustomed to the glowing and unsubstantiated representation made to them as prospective purchasers of gasoline pleasure cars that they fail to distinguish the facts which exist in favor of a commercial device.

We have several splendid advantages in presenting economic facts in relation to the cost of operating electric machines on account of the fairly accurate records which have been kept, particularly in large installations over long periods, covering upkeep of the wearing mechanical parts, batteries and tires, and these three essentials are after all the only items that are subject to the slightest doubt in presenting the cost of operation.

For the purpose of putting some fact forward to substantiate the generally accepted knowledge that remarkable economy may be effected by the substitution of machines for horses, the foregoing table is presented, showing the results of some very complete and exhaustive investigations made with a long period of time devoted to each case and adequate facilities afforded to arrive at an exact knowledge of existing horse cost and to demonstrate beyond question to the prospective purchaser the performance and the cost of operation of the proposed machine equipment. These cases are selected at random from a large collection and represent the transportation departments of prominent and well known commercial institutions in several of the principal cities. The names are omitted purposely, as otherwise this information could not be presented.

FIXED CHARGES AND OPERATING EXPENSES.

HEAVY SERVICE.

Number of Horses	Number of Machines	Investment Horse	Investment Machine	Expense Horse	Expense Machine	Annual Saving	Earnings in per cent of the Investment	Saving over horse expense in per cent
75	44	94,551	166,733	136,746	113,087	23,660	14.2	17.5
30	11	26,615	36,584	44,198	28,378	15,819	43.2	35.7
16	5	7,975	17,784	15,587	11,557	4,030	22.6	25.8
121	60	129,141	221,101	196,531	153,022	43,509	19.6	22.
Relative proportions		(1 to 0.5)		(1 to 1.70)		(1 to 0.77).		

MEDIUM SERVICE.

Number of Horses	Number of Machines	Investment Horse	Investment Machine	Expense Horse	Expense Machine	Annual Saving	Earnings in per cent of the Investment	Saving over horse expense in per cent
35	31	36,485	83,003	91,530	70,663	20,867	25.	23.
17	10	14,300	23,500	29,074	18,972	10,102	42.9	34.
33	20	21,848	51,126	50,249	38,444	11,805	23.	23.3
21	14	39,778	46,170	41,593	31,802	9,791	21.2	23.5
48	37	54,095	75,598	115,284	75,745	39,539	52.3	34.2
154	112	166,506	279,397	327,730	235,626	92,104	32.9	28.
Relative proportions		(1 to 0.72)		(1 to 1.67)		(1 to 0.72).		

Two classes of service are covered in this tabulation, one representing haulage of heavy loads requiring vehicles of two and five-ton capacity and the other group representing medium service where the vehicles are largely composed of one-ton and one-half-ton machines as well as some larger sizes in minor quantity.

The principal feature intended to be developed by the presentation of this table is the saving to be made and its proportionate relation to the existing cost and to the investment necessary to bring about the reduction. It is also interesting to note the proportionate relations between present horse investment and machine investment, as well as the ratio of machine expense to horse expense.

The figures relating to horse equipment are certified to as correct by the respective owners of the installations and the machine equipment has been determined in every case after a complete consideration of the characteristics of the work and extended demonstration with the actual use of machines to prove that the expected accomplishment was practicable. These demonstrated results have been agreed to as convincing and satisfactory by the interested executives in every case, and therefore the entire matter is as nearly fact as it is humanly possible to develop it.

Electric Sign on Roof of Hotel St. Paul, Maintained Jointly by Hotel Company and Central Station.

Attractive Sign in St. Paul.

The Consumers Power Company, of St. Paul, Minn., is not only closing contracts at an encouraging rate, but is taking advantage of every opportunity to impress this on the minds of the people of the Twin Cities. This is evidenced by the accompanying illustration showing a new spectacular roof sign recently installed on the Hotel St. Paul. The sign is 55 feet long and 47 feet high. Seven-foot letters form the words "Hotel St. Paul," and "Light Heat Power by Consumers Power Co." are in four-foot letters. Altogether 900 lamps are employed.

The sign is maintained jointly by the hotel company and the central station, this being an arrangement that could be profitably entered into by many central-station customers and the supply company with mutual profit.

To Boost Electric Cooking at Brighton, Eng.

City Electrician Christie, of Brighton, (Eng.), as the result of experiments that he has made into the cost and reliability of electricity for domestic heating and cooking, has advised the council that he is so convinced of its advantages for consumers of the class that could and would spend fifty dollars per annum on their electricity bill, that he urges a policy of commercial enterprise to push this class of business. Last year Mr. Christie told his committee that the time was fully ripe for doing something definite to cultivate a cooking load in a place which is almost entirely residential and a greatly frequented south coast resort. Now he advises that the speediest success will come from renting the apparatus, and he advises, in the first instance, taking $1,250 from the reserve fund to purchase such apparatus. He says that what small power load Brighton has was brought on by renting motors, and that the experience of success will be repeated if the same principle be employed to popularize electric heating and cooking apparatus.

Electrical Construction

CONDUIT VERSUS OPEN WIRING FOR PLACES EXPOSED TO DAMPNESS OR CORROSIVE VAPORS.

By F. G. Waldenfels.

In the first of these two papers—which appeared in the issue of May 11—different types of open wiring which have been tried in places where there is excessive moisture, extremes of temperature variation, corrosive vapors, or other similar conditions unusually

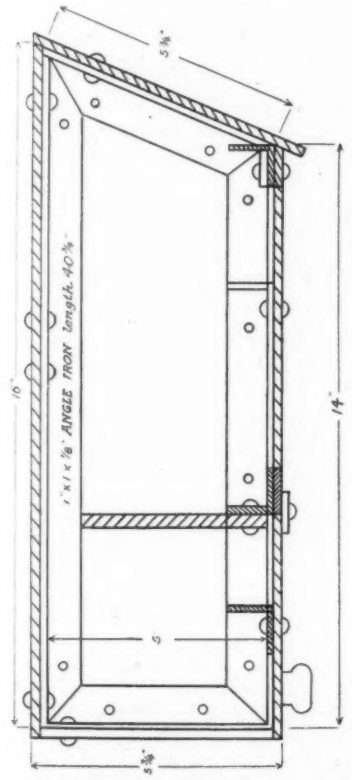


Fig. 1.—End View of Transite Cabinet.

trying to electric circuits, were described briefly, and the advantages and disadvantages of each type briefly enumerated. There was also some mention of the writer's experience with certain fittings in the kind of service under consideration. In this second paper there will be a still further discussion of methods of installing various other fittings and materials, after which our experiments with conduit work will be gone into with more detail than heretofore.

It was pointed out in the preceding paper that we had obtained good results with brass-key sockets, in wet and steamy places, by installing these in a special manner, the method of installation being described. These sockets are of the T-H-base type. It will be recalled that the brass-key sockets are used where the ceiling is especially low and that we were led to try them by the fact that drop wires were sometimes twisted off by the frequent twisting resulting from workmen turning lights out by unscrewing the lamp in the soeket and not holding the socket while the lamp was being turned.

On high ceilings in wet places, where the drops are out of reach, composition-and-mica sockets have lasted very well. Where the temperature is very high, however, these sockets may be tused badly enough to spoil them. With these sockets no sulphur is used for sealing purposes, and hence they do not crack open very easily. In many former types of porcelain sockets a sulphur compound was used for sealing. We found in our work that moisture would cause them to crack as soon as there was any considerable change in temperature. In some of the newer types a more durable filling is used which is free from this weakness. We have also used the hard-rubber molded or mica sockets. In fact, where the lamps are not dropped low and the temperature is not extra high we have found these, cost and other things being considered, the best socket for wet places. If the temperature is extremely high, we advise the use of porcelain sockets.

Where vaporproof sockets have been used in the packing houses, we have had to be very careful to prevent careless workmen from taking off the outer globes and leaving them off. In order to attach an extension in making repairs, the globe is sometimes removed, and mislaid, broken or even lost. The making of such extensions should not be permitted.

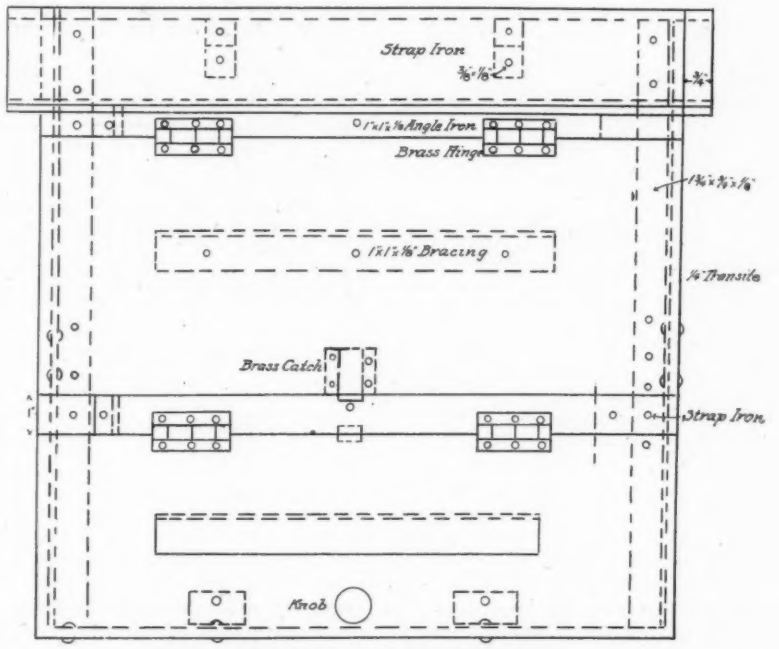


Fig. 2.—Front View of Transite Cabinet.

We have found the T-H-base incandescent lamp to be preferable in very wet places. When 220-volt alternating-current is employed in locations of this nature, the danger of electric shock must not be ignored by the inspector and the property owner. The T-H-base, on account of its peculiar

structure, reduces the liability of one's receiving a shock from the base of the lamp to a minimum. It is unfortunate that the manufacturers of this base have discouraged its use by raising the price. In order to avoid paying the extra three cents per lamp, several risks in our territory have tried using adapters.

Where there is much moisture present we discourage the use of the adapter. We have found that the lining of the adapter may absorb a great deal of moisture, and thus cause short-circuits in the socket. Moreover, if the lamp is unscrewed with the current on, the arc holds and finally burns out the thin contact ring in the base of the adapter. Also, if a brass-key socket—painted and taped in the manner described already—is used with an adapter, the arc, on 220 volts, will invariably hold when the lamp is turned off at the key, and hence in this case, too, the ring will be burned.

We have found rigid weatherproof, conduit-box sockets satisfactory, especially on low ceilings where employees extinguish lights by turning the lamps. By the use of conduit and outlet boxes with rigid socket connections, a fire hazard already mentioned is eliminated.

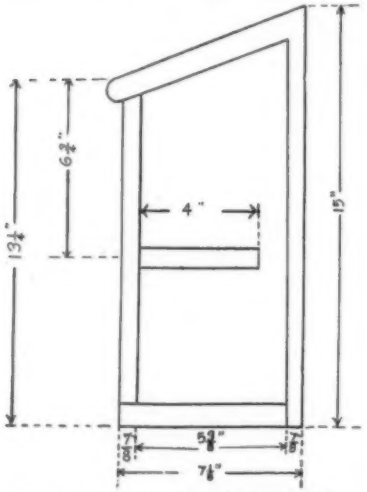


Fig. 3.—End View of Wooden Cabinet.

On very low ceilings where rigid receptacles are liable to be broken, the wiring being in conduit, condulets with porcelain covers may be used and the lamps installed in short pigtail weatherproof sockets, without joints between the lamp and the porcelain cover.

Cutout Cabinets.

In the past wooden cutout cabinets have been given preference in the majority of packing plants. Oftener than not, these are made of pine board seven-eighths of an inch thick. The depth of the box is about 6 inches, inside measurement, from front to back. When the roof is pitched, the back is generally 15 inches high and the front about 13 inches. The number of cutouts to be installed determines the length of the box, of course. Fig. 5 gives the dimensions of a box we have in common use, and the accompanying table shows the correct lengths for boxes entered by one main, and from which specified numbers of branch circuits run. In wet places, it is usually best to make the roof slanting, so as to run off water that might otherwise accumulate on the top and finally find its way to the inside. In the older types, the boxes are lined with asbestos, the thickness of the sheets being from one-eighth to a quarter of an inch. The sheets are usually fastened with three-quarter-inch tacks, and well painted with asphaltum or with similar paint. In some boxes the bottom is made deeper than the top so that the door will better remain shut, it being understood, of course, that when the door is opened it is lifted upward against gravity.

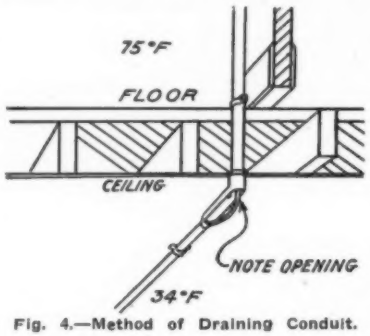


Fig. 4.—Method of Draining Conduit.

It will be noted from the figure that the door is hinged along a line across its middle, as well as at the top. The upper half is held shut by means of two screws. Opening the lower part of the door makes the switches controlling the branch circuits accessible, but leaves the fuses and other live metal parts of all the wiring covered. This arrangement of the box safeguards careless and ignorant employees, and also prevents short-circuits that might occur from the placing of improper objects within the cabinet. As a more complete means of protection, some companies provide a removable partition of asbestos-covered board across the depth of the box from front to back, so that the knife switches and the fuses are in a completely closed compartment of the cabinet. In the case of the box shown in Fig. 5 this partition runs across below the fuses and is held in place by two wooden pins which fit in holes in the bottom of the cabinet. The shield can easily be lifted out of its place whenever access to the fuses becomes necessary.

DIMENSIONS OF CABINETS.

Number of Mains	Number of Branch Circuits	Length of Cabinet
1	3	11 inches
1	5	7 feet 9.5 inches
1	6	2 feet 1 inch
1	7	2 feet 4.5 inches
1	8	2 feet 8 inches
1	9	2 feet 11.5 inches
1	10	3 feet 3 inches

Sometimes wooden cabinets are provided with glass doors which may be lifted just as a window is raised. It is a good practice to keep an incandescent lamp burning in cutout box of this sort—and in the one having a wooden door, too, for that matter. This serves as a pilot light and also tends to keep the inside of the box dry.

Cabinets should be mounted two inches, at least, from the surface which supports them. Support may be made by means of porcelain knobs or 2-by-4-inch timbers. This spacing allows good ventilation, which is very necessary in wet places.

In the packing houses we have tried catches of all descriptions to keep the doors of cutout boxes closed. As yet none has proved entirely satisfactory. The wooden ones get broken and the metal ones are corroded off. The best method discovered yet is to make the

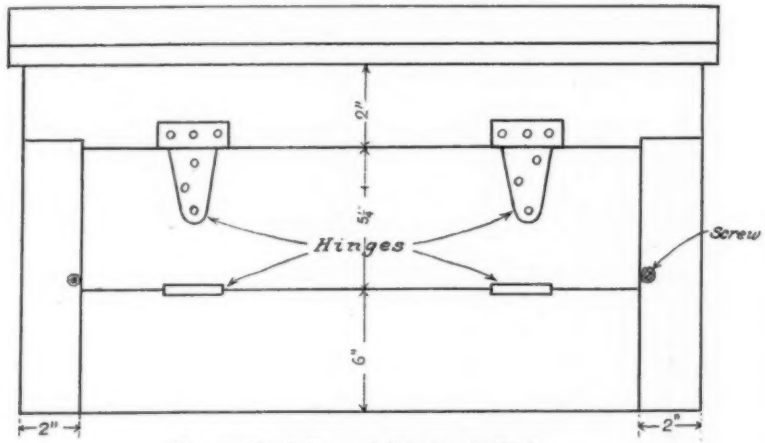


Fig. 5.—Front View of Wooden Cabinet.

bottom of the shutter heavy by attaching a strip of metal along the lower outside edge of it, or by using a round piece of metal in the center of the lower edge. The latter serves as a knob for opening the door as well as a weight to keep it closed.

We have found galvanized-iron hinges to give us better service than any others on these cabinets.

It is best to have all wires enter wooden cabinets through the bottom if there is moisture in the room. The entrance should be made through porcelain tubes properly taped and compounded. In many places conduits are used in running risers from wooden cutout boxes. With such construction as this, flooring pitch should be poured around the conduit where it enters the cabinet; otherwise water is liable to run down the pipe into the box.

It is essential, to be sure, that a cutout cabinet be fireproof. In places where metal cabinets are not favored, boxes made entirely of transite board can be used to advantage. Transite asbestos wood is not affected by flames or heat. Moreover, it's a material that will not warp when water is thrown on it when in a highly heated condition. It is also permanently moistureproof. In one of the large risks in our territory a cabinet made of this material has been installed in a tank house. The construction of the box, which is indicated in Figs. 1 and 2, is as follows. The frame is made of 1- by 1- by ⅛-inch angle iron, copper rivets being used to fasten the parts of the frame together. Except in the case of the top and the door the thickness of the transite board is a quarter of an inch, three-eighths-inch material being used in the door and top. Copper rivets are also used to hold the pieces of board in place. The boards running lengthwise overlap at the edges. All wires enter at the bottom of the box through fittings of the proper type, and there are two compartments, as in the case of the wooden box referred to. This cabinet cost six dollars complete.

Several experiments with steel cutout cabinets in the Chicago packing houses did not produce very satisfactory results. Finally cabinets of the hot-galvanized type were tried, and these have proved very satisfactory.

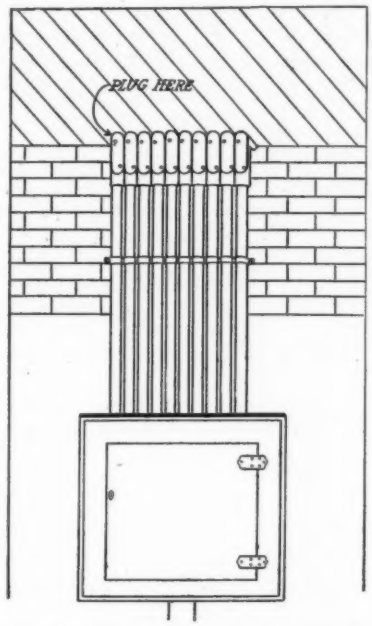


Fig. 6.—Method of Preventing Condensation in Conduit.

They are made of No. 12 U. S. gauge metal, and some of them are in use in a glue house, which is one of the worst of places on a cutout box. A cabinet of this sort has been in use here over a year now. The steel hinges were corroded away rather quickly and had to be replaced with brass ones; but otherwise the box is apparently in as good condition as when it was installed. The metal has turned perfectly white.

It has been found best to have the four edges of the door of the box turned at right angles three-quarters of an inch and have them close against a rabbitt all around the box. A metal stop should be fastened on the top of the cabinet so that the door cannot be raised too high and left open. Also, there should be a metal strip on the bottom of the shutter to act as a weight and thus help keep the door closed.

Cast-iron cabinets have also given good service in the packing houses. They cost more, however, than some of the others and are more liable to be broken. In conduit work they must be drilled for each pipe, whereas with steel boxes the pipes are inserted in the knock-outs. With cast-iron outlet boxes the conduits should be treated with lead at the ends before it is screwed into boxes or condulets. It is a good idea, too, to provide a gasket between the cover and the box, so as to keep the water from the joints as much as possible.

Some Conduit Installations.

In the paper preceding this one some of the difficulties encountered with open wiring in packing plants were enumerated. It was partly because of these that we decided to try conduit work in certain departments. Another difficulty is that it is hard to keep good men for new and repair work on the wages received here. Most of the packing houses in Chicago keep a proficient electrician and an assistant, and a couple of good maintenance men. But when any considerable amount of work has to be done much of it has usually to be left largely to wiremen badly lacking in the skill necessary to insure good construction of this sort. It takes an expert to do really high-class open wiring. Under the conditions which the writer has in mind a better grade of work can be secured with conduit.

A still further consideration is that the buildings here are nearly always undergoing repairs or alterations, and it is found that the carpenters and pipe fitters do not have much respect for electric wiring. Supports are frequently knocked off and the wires left dangling; pieces of metal are thrown across the circuit, or the work otherwise badly treated.

Experiments with all kinds of conduit have been carried on in the pack-

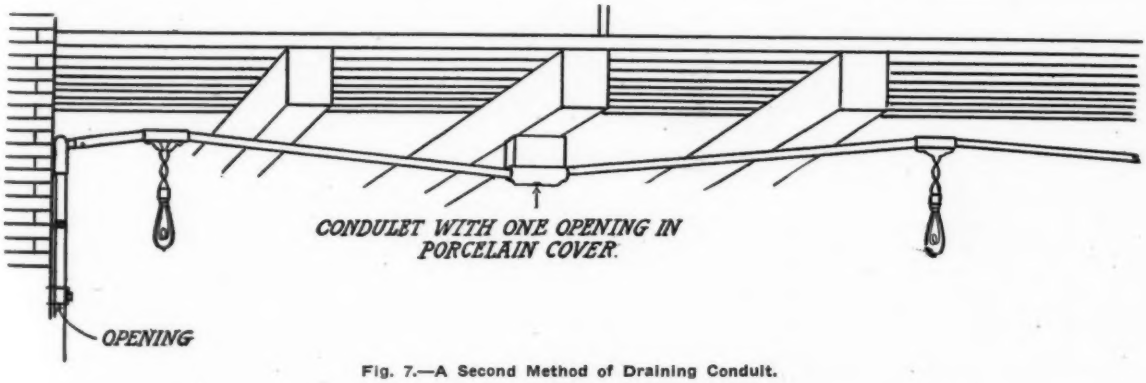


Fig. 7.—A Second Method of Draining Conduit.

ing houses during the last three years, and often in rooms where the conditions are the severest. In many instancs the pipe was corroded badly in a comparatively short time. Often only the shell of the pipe would be left hanging on the wires, and this would result in the insulation breaking down, leaving the circuit in a very hazardous condition. Finally it was decided to try hot-galvanized water pipe for some of the circuits. Before this was installed, of course, it was carefully examined for burrs inside the pipe. The results obtained with this were so satisfactory that it was decided to install hot-galvanized conduit. We have found this, after several months' use, to be very satisfactory so far as freedom from corrosion is concerned. Like the water pipe just mentioned, this tubing turns white after short service, and thereafter there seems to be nothing to dread from corrosion.

clined toward the drains. When switch legs are installed on walls or vertical columns, a drain hole should be left in the bottom of each box.

Fig. 4 shows a method we employ in draining where the conduit extends from a room having an average temperature of 75 degrees Fahrenheit to another in which the temperature is usually about 34 degrees. It will be noted that an opening is provided for the free escape of water.

Still further means of safeguarding circuits against condensation are shown in Fig. 8. Here the pipe is plugged with Chatterton compound to prevent hot air from entering a cold pipe—a process which would necessarily result in condensation. An outlet box is installed as shown. This work of plugging the pipe should be very carefully done.

In Fig. 6 there are shown conduit risers for branch circuits in a passage-

attacked over the boiling tanks; everywhere else it is in good shape.

In pickling departments salt water is continuously condensed on ceilings and walls. One of these was wired with conduit sixteen months ago, and drained as shown in Fig. 7. The circuits are still in excellent condition and no grounds have developed. In another place of this sort BXL has been giving good service for thirty months.

It is interesting to note, also, that a borax mill in our territory is using conduit wiring in the tank room, this being a room in which borax liquid is allowed to steam and crystallize. The installation is standing up well; so well, in fact, that the company is going to change all the wiring over to conduit gradually.

In locations where grease is prevalent, also, we have found conduit to give good results.

Property owners frequently have an

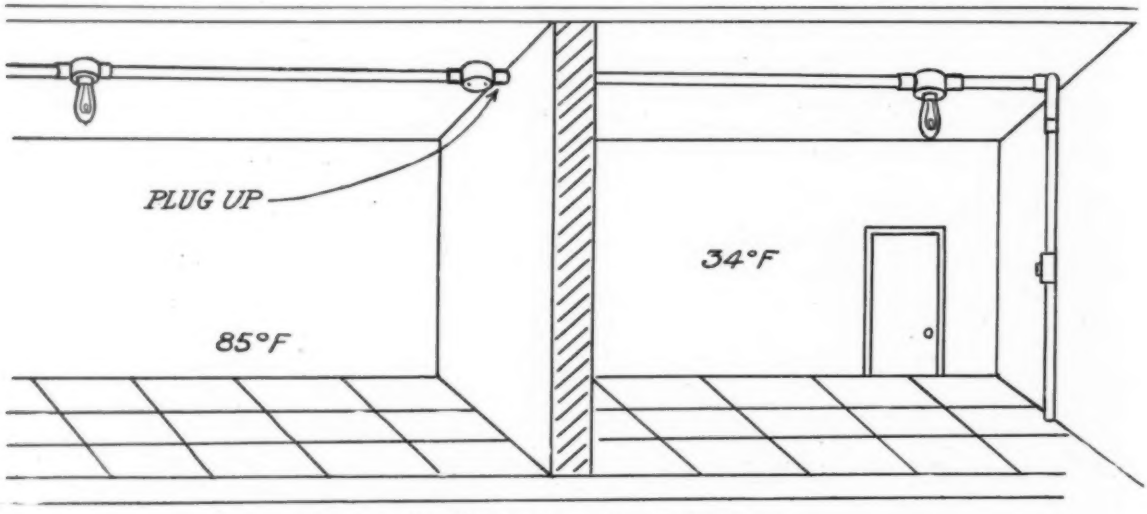


Fig. 8.—Another Method of Preventing Condenastion.

Experiments for finding how to eliminate condensation in conduit have also been carried on by the writer for three years now. It seems that there are two ways of avoiding the evils of condensation in conduit work installed in places especially subject to this trouble. One of these is by draining the conduit by means of gravity between the regular outlets, and the other is by plugging up or interrupting the air passages in the tubes where these pass through partitions between rooms differing in temperature. In a room where there is much steam and where there are temperature variations there is sure to be condensation. In Fig. 7 a method of draining the pipe in a room of this sort is shown. These drain outlets may consist of either a tee or of a fitting with a porcelain cover having one or two holes in it. As indicated in the figure, the pipes should be in-

way where the temperature is 75 degrees usually. The branch circuits run into rooms where the temperature is kept very low.

Sometimes a method of interrupting the conduit at each side of a partition and running through in porcelain tubes is employed where wires pass from a warm into a cold room. The other methods, however, are to be preferred.

In one of the packing plants which happens to be constructed of brick and concrete all the wiring is installed in exposed conduit, and cast-iron outlet boxes are used. This work has been in two and a half years now. Except a few lengths of pipe over offal tanks, which have been slightly corroded, the installation is in excellent condition.

We had a canning department in our territory wired with conduit several years ago. In a recent inspection, we found that the conduit had been slightly

exaggerated idea as to the cost of conduit construction. We have found that conduit work is cheaper than such open work as inverted-tee or pin-and-insulator construction, as these kinds of wiring have to be done in packing houses. In fact, the pin-and-insulator wiring costs nearly twice as much as conduit work. For circuits installed with split knobs on running boards the cost is about the same as for conduit.

As already indicated we are much pleased with the results obtained with conduit service. If the right sort of pipe is used and the work properly installed, it is about 100 per cent better than open wiring for packing houses.

At the meeting of the London Institution of Electrical Engineers on May 16, a marble bust of the late Lord Kelvin was presented to the Institution on behalf of Lady Kelvin.

Red-Lead Joints.

The many jointing materials now advertised as being the best for the purpose have obscured the old reliable red-lead putty.

To make a first-class joint, the white lead used must be unadulterated. Only the properly corroded product of metallic lead bought under a written guarantee should be used. To test for its purity, place a weighed sample in a plumber's ladle and heat; the linseed oil (if putty) will then be driven off and the heating being continued, 85 per cent of the original quantity should reduce into blue metallic lead. Barytes, a chalky substance, refuses to reduce and can be detected by color, appearance and weight from the quantity of lead oxide present in the ladle. If a sample known to be impure is reduced in a ladle against a sample of genuine white lead, the experience gained will safeguard the user against possible future fraud.

It is impossible to stock red lead ground in oil, which is putty, for the reason that it sets in bulk as hard as stone in less than a week; when wanted for paint purposes it is ground as required. This fact explains its peculiar suitability as a jointing material.

The genuine white lead and boiled linseed oil having been obtained, proceed to work up as much dry red lead as possible into the white-lead putty, moistening it with boiled oil while mixing. Its condition at the finish should be quite plastic and soft under the fingers.

Red lead should not be used for joints certain to be repeatedly broken; sheet packing is the best.

Where the face of the flange is pitted or rough, a wire-gauze joint interlaced with a couple of turns of lead wire and filled with red-lead putty, the completed joint being given time to harden, is a good remedy for a joint which proves repeatedly troublesome.

When it is clearly understood that a properly made red-lead joint lasts for the same length of time as the metal flanges, it proves that its choice has rested upon solid merit. Joints broken after 30 years of service without a leak show, when the castings have gone to the scrap heap, that the flange faces were like new metal and were as bright as the day they were machined.—*Power.*

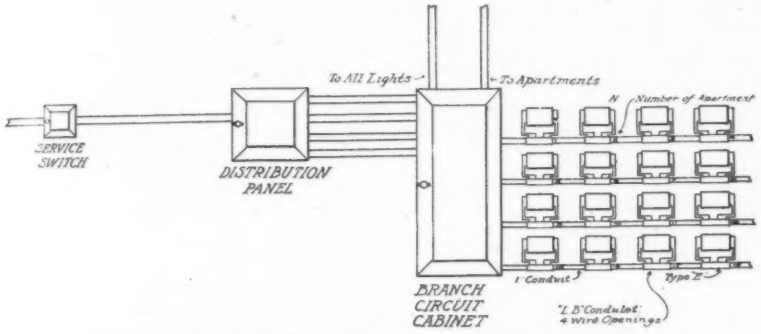


Fig. 1.—Plan of Grouping Meters in Large Apartment House.

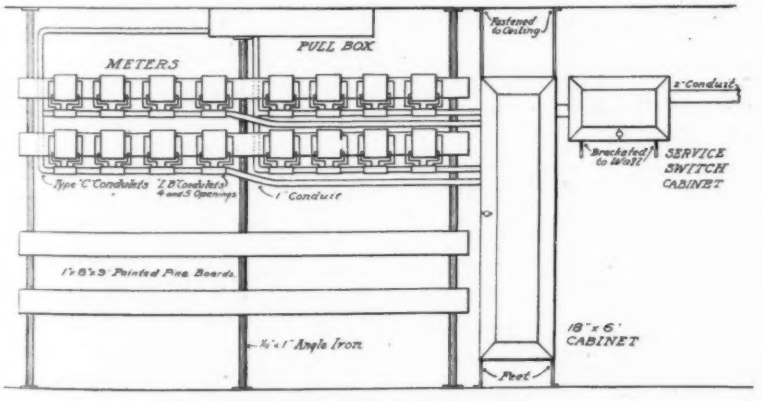


Fig. 2.—Convenient Type of Meter Board.

The cost of electrification of the St. Gotthard Railway, which connects Switzerland with Italy, has been estimated at about $13,000,000, although about $1,000,000 is for new rolling stock, which would be needed in any case on account of the increase in traffic on this line. The first section electrified will be between Erstfeld and Airola.

THE LOCATION OF METERS.

By H. G. Wilson.

In large buildings where there are a number of different tenants, an arrangement that will provide a location for the power and light meters convenient for both the central-station employees and the customers is one that is not always easily found. However, during the past few years several methods have been put into use which have been found to be satisfactory to both of the parties concerned; especially so for the tenants, as the methods used remove the necessity of the repair and meter men entering their premises. In large towns sneak thieves have sometimes represented themselves as central-station employees and gained entrance thereby to apartments. Central stations have profited by the reduced number, or absence altogether, of return calls for meter reading, etc., when the tenants happened to be away from home.

Fig. 1 illustrates one method used in large apartment buildings. The group of meters is usully located in a part of the basement which is easy of access to both the customers and central-station meter and repair men. Conduit is run from the service entrance to the main switch cabinet, generally about 6 or 7 feet, and from there to the distribution-panel board; the size of wire for this purpose being usually determined with reference to the drop, which, as a rule, allows plenty of room for the Code requirements as to the carrying capacity of wire. Each floor is usually sectionalized at the panel board. The separate feeds for each floor pass to a cut-out cabinet large enough to inclose all the branch-circuit fuses, each suite of rooms being separately connected to the necessary number of fuses. The branch-circuit wires then pass through conduit and condulets to the meters, which are numbered or lettered to correspond with those of the apartments. The No. 14 circuit wires are then run, as many as are required for each floor, in conduit to pull-boxes, and thence directly to the lights, etc. Switches and fuses for the hall lights and other building purposes are also located in the central cutout cabinet when this proves to be the most convenient location.

Since the advent of so many electrical labor-saving devices for household use, a circuit of heavier wire is frequently run to take care of the extra current used by them, separate outlets usually located at the baseboards being provided for their connection to the circuit.

It is sometimes found more economi-

cal in buildings housing between forty and fifty tenants, when their construction will permit, to divide the building electrically into vertical sections, and locate the necessary number of meters and fuses in the basement under each section, running to each section with one pair of feeds from the distributing panel, as in Fig. 3.

Fig. 2 shows a meter board built for the purpose, as there was, in this case, no available wall space for the location of meters. The framework is 8 feet high and 9 feet long and is constructed of angle iron fastened to the ceiling and floor. Four one-inch by eight-inch painted pine boards are fastened thereto for the support of the meters, of which there are thirty-two. The service wires are run in 2-inch conduit to the main-switch cabinet, which is 18 by 24 inches, and is placed beside the branch-circuit cutout cabinet—18 inches by 72 inches, and fastened to the wall with brackets made of strap iron, the feed wire being bushed through with Federal bushings.

The circuit wires from the branch fuses are then passed through one-inch conduit and type LB condulets, having either four or five-wire openings as they are required; from here the wires are lowered to the meters. Type C condulets were used to give the conduit a vertical direction to a pull-box placed above and behind the meter board. The conduit is fastened to the framework with the usual pipe straps. The whole board presents an unusually neat appearance for a meter board.

In placing an installation of this kind in a basement it is well to keep in mind the ever present possibility of water and hence to keep it up as high as possible.

New-Code Wire Required in All Sizes.

The Department of Electricity of Chicago is sending out notices to all contractors and supply men in the city that after July 1, 1912, only new-Code wire will be approved in installations requiring the use of rubber-covered wire within the city. This notice applies to flexible cord, fixture wire and those sizes of other sorts of rubber-covered conductors, the use of the old-Code grade of which has not already been discontinued.

In a paper recently read before a London engineering meeting, W. Duddell described an alternator which operates at a frequency of 2,000 cycles per second. The machine is of the revolving-field type and operates at 8,000 revolutions per minute. It has a maximum output of half a kilowatt, and was designed to be used for testing purposes.

LETTER TO THE EDITOR.

Tinning a Soldering Iron.

To the Editor:

In your March 16 issue you published among the dollar wiring kinks an article about tinning soldering irons, by C. A. Walbridge, which is very good. I find, however, that sandpaper is a very good substitute for the tin can he uses, as it cleans the iron while tinning, and is found in nearly every workman's tool bag.

JOE BRAITH.

Madison, Wis., May 22, 1912.

Among the Contractors.

W. H. Brown & Company, electrical contractors, of Chicago, are doing the electrical work for the new Medinah Temple in Chicago.

The Encinal Electric Company has recently been established at 1333 Park Street, Alameda, Cal., to do an electrical-contracting and supply business.

The Middlesboro (Ky.) Electric Company is completing the installation of a street-lighting system in that city. The arc lamps being used are of the magnetite type.

The United Electric Construction Company of Chicago is installing the electrical work in the Tuberculosis Hospital in this city. This plant will be one of the largest of the kind in the entire country.

The Pacific Electric Company, doing an electrical-contracting business in Oakland, Cal., has moved from 686 Sixty-first Street to 5950 Telegraph Avenue.

The company has lately secured the contract for the wiring of the new Nevada City High School, at Nevada City, Cal.

The contract for the wiring of the new building of the King's Daughters' Home, in Oakland, Cal., has been awarded to King's Electrical Company, of that city.

E. C. Wakeland, of Oakland, Cal., has opened a new store at 1602 Clay Street, where he will handle a line of supplies in connection with his contracting business.

Mr. Wakeland is a charter member of the California State Contractors' Association and a director of the Electrical Contractors' Association of Alameda County.

The Western Electrical Supply and Construction Company, successor to the Cooper Electrical Company, has recently moved into larger and more centrally located quarters at 538 Sixteenth Street, Oakland, Cal. This company carries a complete line of electrical goods for the retail trade and does a general electrical-contracting business, having done considerable work in Central California.

Both the members of the company, E. C. Latchem and C. W. Cooper, have had extended experience in the business and are well known to the trade.

A progressive body of men is the Contractors' Association of Alameda County, California, a strong organization comprising in its membership practically every electrical contractor in the towns of Oakland, Berkeley, Alameda and vicinity.

This association was formed in February of this year and from an initial membership of 15 it has grown to a total of over 60 contractors in this short interval. Meetings are held weekly and are well attended. E. C. Latchem is president of the association, and D. T. Griffith is secretary.

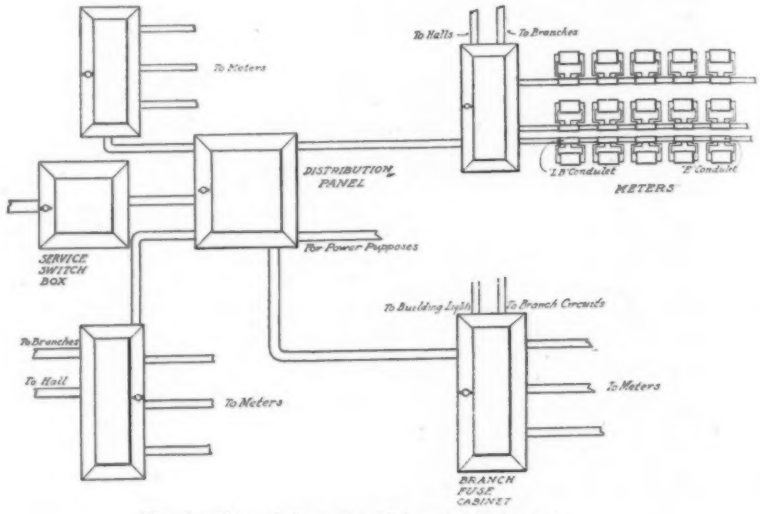


Fig. 3.—Plan of Grouping Meters in Sections.

National Electrical Inspectors' Association

THOMAS HENRY DAY, President.
59 Deerfield St., Hartford, Conn.

JAMES BENNETT, Vice-President,
524 Coristine Bldg., Montreal, Que.

WILLIAM LINCOLN SMITH, Sec'y and Treas.,
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JAMES E. COLE, National Conference Representative,
11 Wareham St., Boston, Mass.

Executive Committee:

H. S. WYNKOOP, Chairman, 13-21 Park Row, New York

Frank R. Daniel, R. P. Strong, Henry E. Knight, Washington Devereux, James B. McCarthy, Wm. Lincoln Smith, James Bennett, C. W. Mitchell, George L. Collison, T. H. Fritts, James S. Meade, Thos. Henry Day, James E. Cole, Thos. D. McColl

Secretary's Message.

The Secretary wishes to say that he had hoped to have a message from President Day—at the completion of a year of service—to put at the head of our column this month.

Instead of that he must extend his personal sympathy to our worthy President in the trouble which he has had to undergo lately, and which he feels sure will be equally offered by every one of our members. Mrs. Day has been threatened with blindness, due to anxiety over the serious condition of another member of the family together with the loss of a little granddaughter. Those of us who know the disposition of our President and have had the pleasure of looking into his home and observing the delightful family life there can well understand and sympathize with him and his under such conditions.

Our representative, Ex-President Cole, too, has been ill recently and was unable to attend the meeting of the National Fire Protection Association at Chicago recently.

Before this appears in print each of the members will have received a note from the Secretary; it is brief but to the point, at least, it was intended to be so; possibly some will think it was too much so, but that was not intended. The Secretary printed it himself, using a job font of type and the number of lower cases available rendered judicious wording necessary in order to have enough to last. He used up every one he had, and trusts this explanation will be acceptable.

Seriously, he would like to have given a personal touch to each one, and hopes that the members will appreciate the intent at least. Just you try this Secretary business once, with an ever present feeling of going shy on question material for this column added to its other troubles, and see if you don't find enough to occupy your spare moments. He is fully aware that the work could be done better and that is why he so plaintively asks for a word now and then from the fellows in the field. They say, "Every knock is a boost," and he will accept them as such, happy if he can even stir you fellows up to kick. But please, oh please, send in some questions and news from the field to help him along, and then last but not least a "plunk!"

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Concerning Three-Wire Service.

Question 180. a. On a three-wire 220-volt circuit with grounded neutral and plug fuses, is it permissible to run three wires through building and connect 660 watts between neutral and each outside wire, making a total of 1,320 watts on the three wires? b. Would it be permissible if neutral was not grounded? c. Would it be permissible if the neutral fuse was omitted? d. Would the substitution of cartridge fuses make any difference?

Answer 1. No to *a*, *b*, *c* and *d*. It is the writer's interpretation of the Code that where the Edison system is used the main shall be three-wire with two-wire branch line circuits balanced on either side of the neutral, which should be grounded.

Answer 2. According to Rule 23*d* it is permissible to load any three-wire branch circuit up to 660 watts on each side, since a load up to this amount would not violate section *d* by making more than 660 watts dependent on any one of the three branch fuses. If the neutral is not grounded, plug fuses would not be permissible (Rule 68*f* and List of Fittings). If the neutral fuse is omitted, this in itself is a violation of Rule 23*b*, second paragraph, which prohibits the omission of the neutral fuse on final branch circuit, and Rule 23*d* would also be violated because such branch circuits from a three-wire

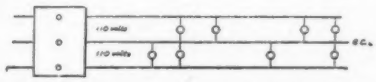

Fig. 1.—Diagram illustrating Question 180.

circuit with fuse omitted in neutral is required to be run as a two-wire circuit.

Answer 3. The four sections of this question can all be answered in one word—No. This general answer is found in Rule 23*d*. In the first paragraph of that section there occurs the following: "Must be so placed that no set of incandescent lamps requiring more than 660 watts, whether grouped on one fixture or on several fixtures or pendants, will be dependent upon one cut-out."

This would seem to apply to paragraph *a* of the above question.

In the second paragraph of the same section, we read the following: "All branches or taps from any three-wire system which are directly connected to lamp sockets or other translating devices, must be run as two-wire circuits if the fuses are omitted in the neutral, or if the difference of potential between the two outside wires is over 250 volts, and both wires of such branch or tap circuits must be protected by proper fuses." Thus the paragraph marked *c* in the question has a direct

answer in the rule. Relative to *b*, I do feel that the condition of the neutral, in relation to the ground, has any bearing upon the question. The matter of the type of fuses, as raised in paragraph *d*, does not alter the spirit of the rule. I am of the opinion, however, that if the wattage limitation, that is, 660 watts, is not passed, it would be proper to approve the circuit as shown in Fig. 1, providing the neutral fuse was not omitted.

Answer 4. *a*. Yes, if the neutral is fused. Rule 23*d*, third paragraph, does not require two-wire circuits if the fuses are not omitted in the neutral.

b. The omission of a neutral ground does not alter the case.

c. No; with the neutral fuse omitted, the ultimate circuits must be two-wire.

d. The substitution of cartridge fuses would not alter the case.

Answer 5. *a*, No; *b*, yes; *c*, no; *d*, no. Rule 23, sections *a* and *b*, permits the omission of the neutral fuse, provided the neutral wire is of equal capacity to the larger of the outside wires and is grounded as provided for in Rule 15. However, under such conditions, Rule 23*d* requires that all branches or taps must be run as two-wire circuits. However, if the system is two-wire 110-220 volts direct-current and the neutral wire is not grounded three-wire branches and taps may be run provided proper fuse protection is maintained. In the case under discussion 110-volt plug fuses would be approved, and insisted upon.

Answer 6. I understand this to mean 220 volts between the outside wires. National Code Rule 23*d*, applied literally, would require a negative answer to each of the questions included under Question 180. If I may be allowed, however, to express a personal opinion as to the intent of the framers of this rule, I should say that they probably did not have a three-wire cutout in mind, and meant rather to limit the amount of energy possible to be interrupted by any final fuse in incandescent lighting work. If the neutral connection be intact, this requirement would be met by the conditions cited.

Interpreting Rule 23*d* as above indicated, rather than literally, I should answer this question as follows:

a, yes; *b*, yes; *c*, no.

The last part of the second paragraph of Rule 23*d* requires the running of two two-wire circuits if the neutral is omitted in the mains.

Answer 7. To parts *a* and *b* of the question my answer is yes; as to *c*, I should say no; *d*, it would make no difference. Rule 23*d* fully covers this question.

Proper Installation of Cabinet.

Question 181. Is it in accordance with the Code to run the feed wires through separate holes of a galvanized-iron cabinet to a cutout in an alternating-current installation? the feeders would have a load of about six amperes.

Answer 1. Yes.

Answer 2. It is perfectly proper to bring the wires from an iron box through separately bushed holes. It would be improper, however, to bring both wires through one hole, unless the wires were in armored cable or conduit.

Answer 3. Feed wires could not be brought into a metal cabinet otherwise than through separate holes without violating Rule 26*h* or 26*r* regarding spacing of wires, if the feed wires are run as open work or concealed knob-and-tube work.

Answer 4. Yes.

Answer 5. Yes; Rule 26*j* requires the wires to enter the box through separately bushed holes as shown in diagram, to maintain proper spacing.

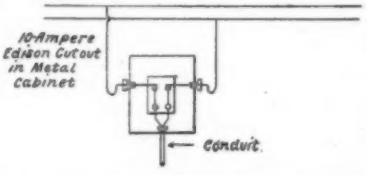

Fig. 2.—Diagram Illustrating Question 181.

Answer 6. Yes. I know of no Code rule to prevent it. This is the usual practice where metal cabinets are used on other than conduit jobs, and we have had no report of any induction or other troubles resulting, even when the load is much greater than in this case.

Answer 7. Yes; that is, if the feed wires were installed as open work or in molding; but if installed in metal conduit, they would naturally pass through one hole in the one conduit.

Answer 8. Of course, the questioner has in mind here the Code requirement that both sides of an alternating-current circuit must be run in one pipe if pipe be employed anywhere on the job, and is probably thinking: How short would a piece of pipe have to be for this requirement not to hold? In the given case it is about as short as it could be. Of course, the only reason for the rule is to avoid the drop in voltage at the receiving end of the circuit due to the inductive reactance of the iron-inclosed single wire, as well as the heating due to the eddy currents set up and to the hysteresis of the iron.

Now, at any possible load and frequency all these effects would be negligibly small, and consequently there is no reason why the two alternating-current wires should not enter the cabinet through separate holes just as they would have to in the case of direct-current—excepting of course in a conduit job, where naturally they would both be in one pipe and enter by one hole in consequence.

Answer 9. Rule 26*p* requires all wires in the alternating system to be in one conduit, and apparently settles the inquiry of this question.

Should Bare Wire and Exposed Terminals Be Permitted on Lamp Bank Used in Testing?

Question 182. I should like to know as to whether the Code rules will allow me to install a testing bank consisting of 32-candlepower, 110-volt lamps with an asbestos backboard, with bare wire running from each receptacle, these latter having exposed terminals? This is only used a certain time and otherwise the switch is open. The full load will be about 25 amperes and is used for meter testing.

Answer 1. The occupancy of the building and the extent of the use and care of such an installation would influence me when passing upon such an installation. It would be better, however, and more in keeping with the Rule if the wires were insulated and if the exposed terminals of the receptacles were covered with tape; but this would entail a hardship in making additions and changes to the testing board. If the care and superintendence were good, I would approve of this form of installation; but, in a testing room only.

Answer 2. The use of bare wire is not sanctioned by the Code. It would be a very simple matter to wire up this lamp bank in accordance with the Code requirements and the extra expense would be negligible. The matter of the total load, or the proposed use of the lamps has no bearing on the question of the Code requirements in the case.

Answer 3. Yes, if installed as a switchboard in a permanent testing room.

Answer 4. No; but Code rules permit the use of such a bank, provided insulated wire (rubber covered or slow burning), is used and proper spacing maintained between wires and the exposed terminals of the receptacles.

Answer 5. Assuming that this question applies to a fixed lamp bank, installed in meter-testing room of a central station; I should consider that Rule 4*a* of the National Code would apply, and would require a slate or equivalent mounting, not an asbestos-covered backboard. Otherwise the indicated construction would be accepted by us, if to be used as stated in a central meter department and under competent supervision. We would require the supply switch to interrupt all of the supply wires.

Answer 6. Yes.

Answer 7. Outside of certain cases coming under Rules 40, 41, 42 and 43, the Code makes no provision for the use of bare wire, except as in Rule 15 it specifies that the ground wire must be insulated, while in Rules 27, 28, 29, it simply says that it must be protected from mechanical injury, thus by implication at least allowing the use of a bare pipe ground wire.

So under the Code I can see no possible way for allowing this wiring.

However, in a testing room there are frequently many things needed for certain testing which would be almost prohibitive if wired in strict accordance with the Code, used for a week or ten days and then stripped down to make room for something else. In such a case, then, where I could be sure that it would be under competent supervision, handled by a skilled operative, and not a permanent fixture, I would permit its use. The Code, it seems to me, can hardly be considered as covering in all details the changing and temporary wiring of a testing room, though, of course, it should govern its permanent equipment.

Answer 8. I fail to find any Code requirement covering the use of an experimental bank of lamps used for testing meters, and, while the construction described is not of the best, I doubt if any harm would be done if it were used by an expert.

A Question of Theater Wiring.

Question 183. The Code requires generally that rubber-covered wire be used for footlights, signs, conduit and other inclosed spaces; but Rule 38*e*, paragraph 6, calls for slow-burning insulation for the wiring of the border proper. A literal interpretation, therefore, would compel the use of rubber insulation for the proscenium side lights, which sometimes extend up and across the arch, making these side lights the equivalent of a border so far as the heating is concerned. Would it not be proper to require slow-burning wire for the side lights?

Answer 1. Slow-burning insulation is not necessarily required.

Answer 2. I think the section referred to in this question is either a misprint or an omission. The heading of the section would seem to indicate this and the language of the heading should appear in the rule: "Borders and Proscenium Sidelights."

The purpose of using the slow-burning insulation is to provide for a safe insulation against the heat of the lamps in the border. The condition in the proscenium side lights is identical; hence they should be treated in the same manner, and slow-burning insulation used.

Answer 3. Slow-burning wire is required for border lights because of the excessive heating, which is liable to occur in a fixture of this type. The inferior insulation of slow-burning wire, is satisfactory for border lights because these fixtures are insulated from ground. I would judge that proscenium lights extending across the upper portion of the arch should be constructed and wired as border lights, and the metal of the fixtures thoroughly insulated. But the side lights would be difficult to insulate from the ground, and, also, the wiring would not need to be protected from the excessive heating; therefore, rubber-covered wire should be used.

Answer 4. We have been obliged in this territory to permit either rubber-covered or slow-burning insulation for the wiring of proscenium side lights; and where the construction is carried partly across the arch, we insist upon slow-burning insulation.

Answer 5. Yes, if the same construction was carried out in the proscenium arch, that is, a metal trough. However, where conduit and other boxes were used, as is sometimes the case, double-braid rubber-covered wire would be required by the writer.

Answer 6. Yes, in my judgment an inspector should require slow-burning wire in the wiring of the proscenium arch, when the conditions are identical with those leading to the similar requirement for border wiring.

Answer 7. Yes.

Answer 8. I should require that the same construction as to wire should be used provided the same conditions as to support held—that is, a metal trough, for instance.

If a change occurred as to conduit and outlet boxes would then ask for rubber-covered wire. That is, it would depend on the similarity of the conditions in the two places.

Answer 9. I think the answer to this question depends upon the definition of the words "border lights" and "proscenium side lights." Assuming border lights to be the borders hung above and parallel with the stage in a horizontal plane, there can be no question as to the necessity of slow-burning wire. The Code requirements as to theater wiring on side walls are explicit, and nothing but approved rubber-covered wire in conduit should be used.

Tungsten Lamps in Bedrooms.

Artificial lighting is seldom required in a bedroom for more than an hour or two per night, and 10 hours' use per lamp per week is probably quite an outside limit for this class of work. Now modern tungsten lamps have a life which frequently exceeds 3,000 or even 5,000 hours, and which probably averages 2,000 hours at least, so that such a lamp in bedroom service should last about 200 weeks—that is, nearly four years. Were there a reasonable prospect of the lamp remaining uninjured for such a period in ordinary bedroom use, there would be no justification for using other than tungsten types, but the trouble is that in four years, the lamp will have to survive at least three "spring cleanings" and innumerable dustings (very often when not burning—despite makers' instructions) at the hands of more or less energetic and none too considerate servants. A year or two ago these considerations were very serious, and numerous authorities definitely condemned the use of tungsten lamps in bedrooms, but the recent improvements in the manufacture and reductions in the price of these types have greatly altered the position, so that if a life of nine or twelve months free from mechanical breakage can be guaranteed, there is now rarely any difficulty in demonstrating economic advantage for them.—*Electricity.*

Large Power Contract for Maine Company.

The Central Maine Power Company of Waterville and the Rockland, Thomaston & Camden Electric Railway at Rockford and vicinity have entered into a 20-year-contract, by which the former will furnish all the electric energy used by the latter in its various enterprises. It is the largest contract for electricity ever made in Maine. Construction will begin at once on a 40-mile transmission line from the power company's lines at Winslow to the railway company's lines at Warren. The transmission line will be over a private right of way.

Among the Supply Men

Electrical Supply Jobbers' Association Votes to Co-operate with Underwriters' Laboratories in Rubber-Covered Wire Inspection.

At the meeting of the Electrical Supply Jobbers' Association at Atlantic City last week, Hugh T. Wreaks, special agent of the Underwriters' Laboratories, Incorporated, presented a resolution recommending certain features of co-operation on the part of the jobbers of the country with the Underwriters' Laboratories to increase the value of factory-inspection service of rubber-covered wire. After explaining his resolution, the Association granted its unanimous approval of the suggestions.

In the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of January 13, 1911, Mr. Wreaks, in an article entitled "Examinations and Tests of Rubber-Covered Wires," outlined in considerable detail the merger of the Wire Inspection Bureau, the National Electrical Code Rubber-Covered Wire Service and the Underwriters' Laboratories. Substantial improvement upon the new specifications and a single inspection service have been brought about among the manufacturers of rubber-covered wire, and the details of the inspection and tests, and the general scheme of examination are described in the article above mentioned.

In the resolution presented at Atlantic City, Mr. Wreaks proposed that arrangements be made for individual jobbers in various towns all over the country to collect samples of rubber-covered 1911 Code wire and send these, together with reports covering certain points to the New York office of the Underwriters' Laboratories. These samples are to be about four feet long, principally No. 14 and No. 12, with such occasional samples of larger sizes as special conditions may make advisable. These samples are to be tagged with information giving the date of manufacture, the serial number of the label and the denomination of the label, the number of feet and name of manufacturer, all taken from the tag on the coil and the price at which wire is being retailed or wholesaled. All information of this character will be treated as confidential and followed up as promptly as may be necessary by direct representatives of the Underwriters' Laboratories. Informal reports on samples received are also to be arranged for.

It is also proposed that the Jobbers' Association recommend that on every important installation the inspection departments having jurisdiction (either Underwriters or Municipal, or both) examine and verify the distinctive marker in the wire used and make this item, together with the name of the manufacturer, and if possible the trade name of the wire, a part of their inspection-department record.

The method outlined is proposed to supplement the elaborate procedure and field follow-up systems provided in the present factory inspection and label service of the Underwriters' Laboratories on rubber-covered wire. This scheme, if followed out all over the country in a couple of hundred cities, would give information on thousands of installations where the make of the wire used was a matter of record and would establish a substantial preliminary to a follow-up of the service value of such wire.

It is also proposed that in order to obtain service values some system of tests on completed installations should be called for. This would show the physical condition of ends of circuit wires and insulation-resistance tests on typical sections of installations. In order not to disturb present wire conditions too greatly such tests should preferably be arranged for as follows: When building is wired up for the first time, and after the wires are installed and before fittings are connected, a typical section should be selected by the inspector and tested for dielectric strength and insulation resistance. These tests should be a part of the record of the inspection department, and the condition of the wiring of buildings tested should be judged by similar retests made at stated periods on selected sections. Failure on the part of the section would call for tests on the entire building and the taking out of defective circuits as found. Per contra, a good test would mean that such a building was safe until the next periodical inspection obtained. These tests should be made at intervals of two years at the start, and at intervals of five years when firmly established.

Similar tests have been made with some success in various installations in New York and Brooklyn. They have been made on underground circuits by electrical companies and on signal circuits by railroads. Mr. Wreaks stated that these tests are absolutely practical and that the Underwriters' Laboratories were prepared, provided the Association endorsed such tests, to outline in detail the apparatus required and the exact procedure to be followed.

The H. I. Sackett Company of Buffalo, one of the big wholesale jobbers of the country, does a considerable retail business. The company covers western New York. The business was established in 1897 and incorporated in 1907.

The Electric Traction Supply Company, St. Louis, Mo., retails to a very small extent, devoting itself principally to wholesaling and the manufacture of special material. The company is carrying on a special sales campaign on fare boxes for street cars, and fans, and lamps. The selling organization covers the Southern States and part of the central and western portion of the country. O. W. Uthoff, president of the company, recently made a special trip through the South with his sales organization and reports prospects very bright. The business was established in 1902.

Woodward, Wight & Company, Ltd., New Orleans, La., is building a new warehouse and office building. The electrical department of this business was established in 1908, the selling organization covering Louisiana, Texas, Mississippi, Arkansas and part of Oklahoma. The officers of the company are: J. B. Simmons, president; J. G O'Kelly, first vice-president; C. French second vice-president; A. E. Ugland, third vice-president; F. C. Bickers, secretary. The company does not cater to retail business, devoting itself entirely to wholesaling.

The Reading Electric Company, Reading, Pa., reports considerable activity from the construction field. This business was established by John J. Witman in 1901, dealing principally in the eastern portion of Pennsylvania.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS.

Fifth Annual Convention at Little Rock.

The fifth annual convention of the Arkansas Association of Public Utility Operators met at the Marion Hotel, in Little Rock, on Monday, May 20. With ideal summer weather, most of the members were on hand early and the program scheduled for Monday forenoon was begun. This consisted of routine business and reports and the address of President J. M. Hewitt, of Mariana, Ark. His prediction of a record-breaking convention was amply fulfilled in the last two days of the session.

On Monday afternoon, W. H. Walkup, superintendent of the Batesville Water and Light Company, read an excellent paper on "Troubles and Remedies," with special reference to the operation of small and moderate-size plants. He finds that the solution of plant troubles falls on one man, the superintendent, and his resourcefulness and ingenuity are often called into full play. He mentioned a number of improvements in ways and means of operating boiler and engine rooms so as to cut out, as far as possible, all waste. By using a tally-counter to record each barrow of coal and a water-meter on the boiler-feed line he keeps continual watch of boiler efficiency.

This paper was discussed by several members, who agreed that water-supply service has many more troubles than electric service.

Mr. Walkup's paper was followed by one on "Uses of Electricity," by W. N. Gladson, of the electrical engineering department of the University of Arkansas. He mentioned briefly the early history of the subject, tracing it down to present times. He called attention to the rapidly increasing use of electricity in railroading, mining, machine shops and manufacturing industries. The great industrial advance of the Southern States is largely due to their hydroelectric developments of the past fifteen years. He noted the extensive electrochemical industries, such as the refining and separating of copper, aluminum, gold, silver, etc., and also the production of ozone and nitric acid. The electric furnace is especially useful where electricity is cheap and coal dear. The effect on city and country life of the telephone and trolley car has been very beneficial, helping to make tenement houses entirely unnecessary. The application of electric power to farming operations is opening new markets for power while the countless heating devices for domestic and commercial use have provided a day load undreamed of twenty years ago. Professor Gladson closed his most instructive paper with a review of the inefficiency of steam generation of power and the desirability of more water-power development, both for the conservation of fuel and the checking of excessive floods.

The remainder of Monday afternoon was devoted to a general discussion of various subjects.

B. C. Fowles, of Pine Bluff, opened the subject of the sale of lamps. His reason for controlling sales and not leaving the business to electrical contractors and dealers is that usually the consumers can be persuaded to use larger sizes of lamps if properly solicited. He sells no 25-watt lamps and, by selling at cost, gives the consumer 60-watt Mazdas at about the same price the dealers would charge for the 40-watt size. The dealer has no motive to try to sell the larger sizes of lamps except his profit on the sale.

Mr. Patterson, of Fort Smith, discussed methods of promoting the sale of power. His company favors trial installation of motors, which, if satisfactory to the user, are paid for in 30, 60 and 90-day payments. He is opposed to renting motors, because a renter will not take the care and have the interest in an article that an owner will.

Several members discussed plans of special house-wiring campaigns, all believing that they are very desirable.

Arthur Smith, of the Little Rock Railway & Electric Company, told of the good results accomplished by the Electrical Club of Little Rock. This club is composed of all who are interested in electrical lines, and meets during lunch hour once or twice a month. Better co-operation of the supply men and contractors with the company has been noticed since its organization.

On Tuesday morning T. A. McDowell, of the Westinghouse Electric & Manufacturing Company, read a very comprehensive paper on "Metering and the Equipment of Central-Station Laboratories." He outlined the necessary characteristics of direct and alternating-current watt-hour meters and the several forms of primary and secondary standards for checking meters. The interval between periodic tests of watt-hour meters should be decided from the value of results obtained, but should not be longer than two years.

In closing the discussion on the paper, Mr. McDowell explained the effect on meter accuracy of changes in voltage, frequency and power-factor.

D. A. Hegarty, of New Orleans, told of his experience with an ordinance of that city which requires the city inspector's seal on each meter installed. He thinks that a test, when requested, in presence of the city inspector is ample assurance of a meter's accuracy.

Mr. McDowell then led a short discussion on various types of lightning arresters.

On Tuesday afternoon the secretary read a paper on "Water Power in Arkansas," prepared by E. C. Bellamy, of Mammoth Springs Electric Light & Power Company, who was unable to be present. This paper describes the Mammoth Springs power development and 36-mile transmission line, the first steel tower line in the state. It also calls attention to the fact that there are a number of rivers in Arkansas which possess very good power sites. The conservation policy which withholds water power from development was emphatically condemned and a committee to draft suitable resolutions along that line was appointed.

V. A. Hain then read a paper on "Establishment of Day Circuits," prepared by H. J. Mauger of the General Electric Company. This paper considered the case of plants in cities of less than 5,000 inhabitants. If 100 flatirons can be sold in the town the extra revenue from them will ordinarily repay the extra expense of day circuits, and then fans and small motors can easily be sold, making a good profit in almost any town of 1,000 or over. Refrigeration and water pumping make a very good form of day load and domestic motors and heating devices are very strongly recommended. By proper personality and management of a lighting company a per capita revenue of $3 to $5 per annum can be raised to $10 to $15.

This paper was followed by a very spirited discussion of day loads, lasting the remainder of the afternoon. Cooking stoves, constructed on the fireless principle, were strongly indorsed, as were also electric incubators.

On Wednesday morning, A. E. Smith, of the Little Rock Railway & Electric Company, read a very pithy paper on "Sale and Uses of Electric Heating Appliances." He favors the trial installation of and installment payments for electrical devices. The salesman or solicitor should not talk "watts" to a prospective customer, but should state in cents per day the average expense of using any device. The central-station men should have first-hand information on the use of devices sold and should always have in their exhibit room a well selected line of appliances.

Mr. Gillette, of Fort Smith, reported great success in placing irons in use by having a department store sell the irons from a consignment stock. Mr. McClendon, of Fayetteville, reported that a young lady solicitor succeeded in placing 482 irons among 780 customers on his lines. F. N. Jewett stated that a roast of beef weighing eight pounds shrinks to five pounds in a gas

oven, while in an electric roaster the shrinkage is almost *nil*.

Mr. Hewitt, of Mariana, stated that he gives to each newly married couple in his city an electrically heated device as a wedding present.

F. N. Jewett, of the Wagner Electric Manufacturing Company, then read a paper entitled "Unity-Power-Factor Motor as Related to Single-Phase versus Polyphase Distribution."

M. Q. Woodward, of Pine Bluff, then presented a very complete paper on "Ornamental Street Lighting," closing with a description of the posts and the methods of selling them used in Pine Bluff. This company closed its campaign with a big White-Way-Day celebration, when current was turned on 122 posts along the principal business street. The post is made of iron pipe carrying four 60-watt tungsten lamps in 16-inch opal balls. Mr. Fowles, manager of the Pine Bluff company, thinks that the White Way has increased the popularity of the company with the citizens more than any other thing which it could have done. Incidentally, the monthly payments will cover the cost of installation the first year, and after that the payments will be reduced so as to net a return of approximately 7.5 cents per kilowatt-hour.

The convention then went into executive session and elected the following officers for the ensuing year: J. W. McClendon, Fayetteville, president; W. C. Maguire, Arkadelphia, first vice-president; J. F. Christy, Jonesboro, second vice-president; A. E. Main, Hot Springs, third vice-president; W. J. Thorpe, Little Rock, secretary-treasurer.

The chief entertainment feature was a banquet given by the Class B members on Tuesday night at the Marion Hotel. C. J. Griffith, of the Little Rock Railway & Electric Company, presided as toastmaster, and many men of many minds, but all with best wishes for the Arkansas Association, made speeches.

Adjoining the convention hall, the H. W. Johns-Manville Company had a very complete display of electrical devices and asbestos products, lighted by tungsten lin-o-lites and inverted bowl fixtures.

The Wagner Electric Manufacturing Company display consisted of one of its standard five-horsepower motors and a five-horsepower unity-power-factor motor, connected to a switchboard having three ammeters. The battery-charging rectifier was also exhibited.

The Century Electric Company had a display of fans and small motors.

The Westinghouse Electric & Manufacturing Company had a very complete line of heating devices ready for demonstration.

Committee on Organization of the International Electrical Congress in 1915.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers on May 21, the president announced the appointment of the following members of the Committee on Organization of the International Electrical Congress to be held at San Francisco, Cal., in 1915. The Committee is not yet complete.

There are also a large number of members from the Pacific Coast and other members at large.

Charles P. Steinmetz, president; Arthur E. Kennelly, C. O. Mailloux, W. D. Weaver, Henry A. Lardner, vice-presidents; Edward B. Rosa, secretary; Preston S. Millar, treasurer and business manager. The above officers constitute the Executive Committee.

Representative Members from the American Electric Railway Association: Henry W. Blake, Frank R. Ford, Edwin P. Katte, Henry G. Stott.

American Electrochemical Society: Charles A. Doremus, Carl Hering, Willis R. Whitney.

American Physical Society: Frederick Bedell, C. F. Burgess, E. L. Nichols.

Association of Edison Illuminating Companies: Alexander Dow, Louis A. Ferguson, John W. Lieb, Jr., Joseph B. McCall.

Association of Railway Electrical Engineers: Jesse H. Davis, Charles R. Sugg.

Association of Iron and Steel Electrical Engineers: E. Friedlander, B. R. Shover.

Colorado Electric Light, Power & Railway Association: J. F. Dostal, F. P. Wood.

Electric Vehicle Association of America: W. H. Blood, Jr., F. W. Smith, P. D. Wagoner.

Empire State Gas and Electric Association: C. R. Huntley, R. M. Searle.

Illinois Electrical Association: E. J. Berg, F. M. Sinsabaugh.

Illuminating Engineering Society: E. P. Hyde, V. R. Lansingh, L. B. Marks, A. S. McAllister.

Indiana Electric Light Association: W. D. Ray.

International Association of Municipal Electricians: William Brophy, W. M. Petty.

Iowa Electrical Association: A. H. Ford, L. B. Spinney.

Maine Electrical Association: H. W. Eells, W. K. Ganong.

Minnesota Electrical Association: Paul Doty, H. J. Gille, G. D. Shepardson.

National Bureau of Standards: Samuel W. Stratton.

National Electrical Inspectors' Association: F. R. Daniel, Hugh T. Wreaks.

National Electric Light Association: C. L. Edgar, W. W. Freeman, F. W. Frueauff, John F. Gilchrist, Samuel Insull, T. C. Martin, Arthur Williams.

New York Electrical Society: H. L. Doherty, G. H. Guy.

Electrical Testing Laboratories: Clayton H. Sharp.

Franklin Institute: W. C. L. Eglin, R. B. Owens.

Ohio Electric Light Association: F. C. Caldwell, F. M. Tait.

Society for Promotion of Engineering Education: H. H. Norris, Samuel Sheldon.

Institute of Radio-Engineers: J. L. Hogan, Jr.

Southwestern Electrical & Gas Association: F. M. Lege, Jr., A. C. Scott.

Western Society of Engineers: W. L. Abbott, Harold Almert.

Wisconsin Electrical Association: P. H. Korst, R. H. Pinkley.

BOOK REVIEW.

"Storage Batteries." By Harry W. Morse. New York: The Macmillan Company. Cloth, 266 pages (4½x7¼ inches), 106 illustrations. Supplied by the Electrical Review Publishing Company for $1.50.

This compact and useful book on storage batteries is by the assistant professor of physics in Harvard University. The sub-title of the work, "The Chemistry and Physics of the Lead Accumulator," is a better statement of the aim of the volume than the main title. No attempt is made to cover the detail of storage-battery engineering, but the entire work is devoted to an interesting and sane study of the storage-battery cell itself. Primarily the lead-sulphuric-acid cell is studied, this being the type in general use. The only other type now commercially available, the Edison battery, is treated in some detail, but not completely, due to the lack of knowledge at the present time of the "fundamental equation" of that type of battery.

The storage cell is discussed first from the chemical side, later from the physical side; and in order that the reader form proper concepts of the working theory used to explain the lead cell, the first portion of the work deals with fundamental electrochemical reactions in both primary and secondary cells, and following the fundamental law of Faraday, gives in detail a clear and practical theory which covers all or almost all the known reactions of the lead battery.

A valuable feature of the work is the liberal use of curves to show the various characteristics of batteries, many of them being given to illustrate the modern ratings of batteries at high charge and discharge rates. The processes of manufacture of modern plates, and their uses and abuses, are well covered, and the reader is given sufficient information to bring him well in touch with the most advanced practice of the day.

Based, as the book is, on a series of lectures at Harvard University, the result is not only a textbook of value, but also a technical work worthy of the attention of all employed in the production or care of storage batteries. It is so clear and interesting that as a general work it can be read with pleasure and profit by all owners of batteries. The mathematics used, and the chemistry incidental to the storage cell, are so plain that any one of average intelligence should be able to follow the author with ease.

A. B. Burk, Jr.

General Aspects of Industrial Lighting.

By L. B. Marks.[1]

This article treats of a few aspects of the problem of artificial illumination in industrial plants. Bearing on the importance of this subject, it is pointed out that the value of the annual output of such plants in the United States probably exceeds twenty-five billion dollars. While it is true that the bulk of the work is done by daylight, it is also true that year after year an increasing amount is done by artificial light.

The great development that has taken place in lamps and lighting devices makes it possible to use artificial light far more advantageously and economically today than ever before. In fact, the improvements in artificial lighting have made it possible to do work at night that heretofore could be done only by daylight. Whereas until comparatively recent years we were very limited in our choice of lamps and in the control of the quality of illumination, we can now provide light which for some purposes is practically as good in quality as daylight. More than this, we can for specific classes of industrial work provide artificial light of such quality as to enable us to execute the work even better than we can by daylight itself. This does not mean that we have solved the big problem of artificial daylight, but it does mean that we have made such great strides toward its solution that when daylight fails us we have a good substitute for most purposes. Daylight varies considerably in quality and intensity from hour to hour, even from minute to minute, whereas our substitute is invariable and can be depended upon at all times.

1 Consulting Illuminating Engineer.

Until recent years, the electrical engineer concerned himself mainly with questions relating to the generation and transmission of current and his efforts were devoted to designing lighting installations that would deliver this current to the lighting outlets in the most efficient and economical way.

Similarly, the gas engineer was concerned largely in securing the most efficient and economical generation of gas and the best distribution of the gas through the pipes to the outlets where it was used. The greatest refinements in engineering for the saving of a few per cent in the cost of generation and distribution were made. These economies were, however, in some cases far more than offset by the great losses which occurred in the actual utilization of the current or gas, as the case might be, for lighting purposes. It was no uncommon occurrence to find one-quarter to one-third and sometimes even one-half of the power delivered to the outlet actually wasted, so far as any useful purpose for illumination was concerned.

Then followed a period of great activity, which is still continuing, in improving efficiency and effecting economies in the use, as distinguished from the generation and distribution, of both electricity and gas for lighting purposes, with the result that today we may safely say that on the average we are getting at least 25 per cent more useful illumination than we did five years ago from the same lamps, using the same amount of power.

Fig. 1.—The Shelton Mills.

Efficiency Engineering.

In considering the general aspects of industrial lighting it is a striking fact that the great advances made in illumination are analogous to corresponding advances in efficiency engineering, though less capable of exact determination.

In these days of the efficiency engineer and efficiency engineering, methods of accounting, industrial processes, the detailed operations of the individual machine and of the individual workman, are closely scrutinized, and elaborate tests covering long periods of time are made to ascertain where possible economies may be made. The manager of the industrial establishment now has convincing evidence that the work thus undertaken has tangible and far reaching results. It is significant, however, that with comparatively few notable exceptions, the rank and file of industrial plants throughout the country have not yet awakened to the ultimate economy that would result from efficiency engineering in illumination, that is to say, from the best utilization of light for the specific classes of work done.

The manager of the industrial plant is now employing the efficiency engineer to carry out a class of work which in a way might be compared with that of the electrical and the gas engineer of years ago. The problems in industrial engineering are so numerous that the plant manager, for the time being, has all he can do to attend to those which seem to him the broadest and most important. He has not yet, generally speaking, gotten down to the problem of efficient utilization of light, and while he is effecting a saving of say 5 per cent at the mechanical end of the line, he is overlooking the possibility of securing an

ultimate saving of 10 per cent by attention to the illuminating end.

We have accurate data of tangible improvements and economies effected by efficiency engineers in a great variety of operations in industrial plants, but as yet we have very little recorded specific data on the tangible improvements and economies that may be effected by good illuminating engineering in these plants. One reason for this no doubt is that in the matter of illumination the number of variables to be taken into consideration is so large that it is sometimes difficult to directly trace a tangible result to an improvement in the illumination, and all the more difficult when this result requires a long time for demonstration.

Very often the idea of the factory manager is that the work of the illuminating engineer should be primarily to cut down the cost of his lighting. Some three years ago the writer was employed by the manager of a large industrial plant (Shelton Mills, Conn.) to examine his mills for this very purpose, namely, to cut down the cost of lighting. It developed as a result of the examination that the lighting of the works was wholly inadequate, and the manager was advised that for the proper illumination of his establishment at least three times the amount of current then used would be required. It was pointed out to him that ultimate economy would be effected by this increased expenditure for light. He commented that the present lighting was satisfactory to his workmen and at first did not take kindly to the idea of spending several thousand dollars additional each year for better lighting. However, the new plan was tried out in one building and subsequently in others, until finally the lighting equipment of every building in the group was remodeled to conform with the original recommendations. The system of lighting that was formerly used in this establishment is what is known as the strictly localized system, in which each machine or workbench, as the case may be, is provided with a local lamp placed close to the work. This system until a comparatively few years ago, was typical of lighting practice in a majority of the industrial establishments in this country, and is still extensively used.

Many managers of industrial establishments seem to have the idea that the most economical way of lighting is to mount a small lamp close to the work to be lighted, and that if the lamp is placed at some distance from the work a good deal of the light is wasted because it does not directly reach the working surface where it is needed. Fortunately, however, this so-called "spot lighting" method is gradually falling into disfavor and managers of plants are coming to a realization of the fact that ultimate economy is not conserved by brightly lighting local spaces with the rest of the room in comparative darkness, and that as a rule the best system of lighting is that in which the entire room is illuminated with well diffused and directed lighting from suitably shaded lamps, placed so far as practicable, out of the ordinary field of vision, and if necessary, supplemented by well shaded local lamps where a very high intensity of illumination is required.

It costs less for light to illuminate by strictly local or spot lighting, but there is no ultimate economy in this method of lighting.[2]

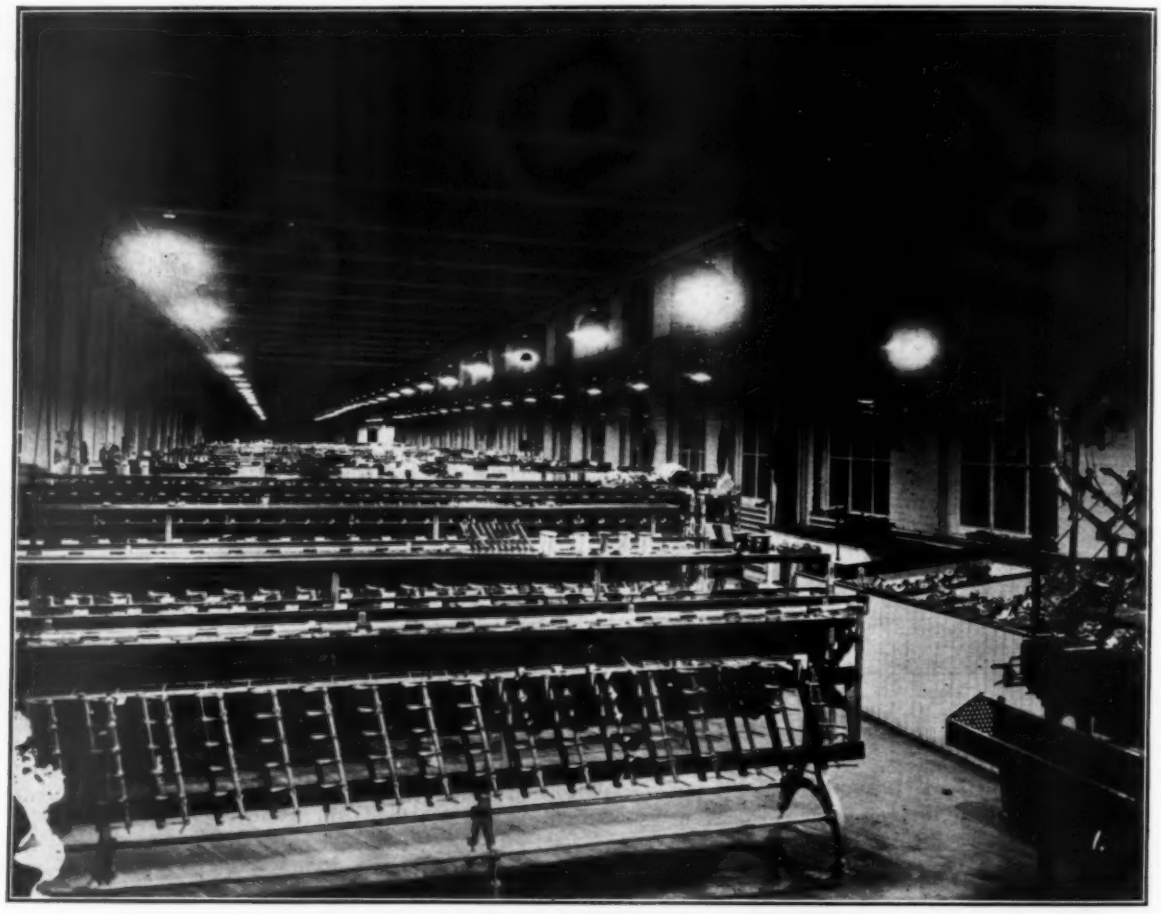

Fig. 2.—Example of General Illumination in an Industrial Plant.

2 For tests, and detailed discussion of this subject, see paper on "Factory Lighting," by L. B. Marks, *Trans., Illuminating Engineering Society*, Vol. IV 1909, p. 805.

Ultimate Economy.

To secure ultimate economy in illumination the manager of the industrial establishment must consider among other things:

(1) The ability of the workman to see all parts of his work well during the entire period of time that he uses artificial light. This means that the diffusion, direction, intensity and color of light should be such that the workman can carry on his work for prolonged periods with the least possible eye-strain. Furthermore, it means that the output and quality of the work will not suffer as a result of improper illumination. As the lighting cost is only an extremely small fraction (often less than one per cent) of the cost of labor and material of a manufactured product, it follows from the above that ultimate economy may result even if the lighting cost is largely increased.

(2) There is no ultimate economy in using very bright lighting sources suspended within the ordinary field of vision of those working in the room even though the actual intensity of illumination on the work may be considerably greater than it would be if the lamps are inclosed in diffusing globes or shades which soften the light. The price of good diffusion may be 25 per cent of the total light generated, but by the sacrifice of this 25 per cent the usefulness of the light for seeing purposes is greater than it would be if brilliant lighting units are used.

(3) Again, the amount of light that reaches the objects to be illuminated may be, *per se*, of less importance than the direction from which the light comes. The factory manager usually gives most careful attention to the placing of his machines, workbenches, tables, etc., with reference to the best direction of daylight on the work, but often fails to give equal attention to the best direction of artificial light on the same work. Thus it frequently happens that the systematic scheme adopted for daylight conditions is completely overturned in artificial lighting. While it is true that in the present state of the art it is rarely possible to obtain the same directive effects by artificial light as are obtained in daylight, a fairly close approach to the daylight conditions can often be made without undue expenditure of power for lighting. Indeed, by remodeling the lighting to secure proper direction, it has been found possible and even desirable in some cases in practice to cut down the actual intensity of illumination more than 50 per cent.

Fig. 3.—Example of "Spot-Lighting" in an Industrial Plant.

(4) "Technical" efficiency of a lighting installation, that is to say, the ratio of the light delivered on the objects to the total light generated by the lamps, is not to be taken as a measure of the visual efficiency of the light. It follows from what has already been stated that of two lighting installations, the technical efficiency of one of which is double that of the other, ultimate economy may result from the use of the installation having the lower technical efficiency. The true criterion always is the ability to see well, and the percentage of light delivered on the work is only one factor and often a secondary one in comparing the real illumination value of lighting installations.

(5) As a general proposition, artificial lights having a color approximating as closely as possible that of average daylight, are safest for general use. However, there are numerous cases in practice in which artificial lights having a distinctive color value can be used to great advantage. Thus for example, in foundries and other establishments in which the atmosphere is likely to be filled with smoke, the light of the yellow flaming arc has a distinct advantage in that its rays penetrate smoke more readily than do those of other lamps. Again in many cases in industrial work, the monochromatic light of the mercury arc lamp is very advantageous because of the color contrasts which it produces; though objectionable where true color discriminations are required, this light assists in quick and close discernment in some classes of work, and for some purposes may be even more efficacious than daylight.

Not only the color of light but the color of the ceilings and walls of the room has an important bearing on the ultimate economy of lighting. It is a well known fact that light-colored ceilings and walls reflect a larger percentage of light than do darker colors, and add greatly to the general illumination of the room. Mat surfaces are always better than glossy or shiny surfaces because the latter cause annoying reflections of light which decrease the visual sensibility. Hence, when walls are painted, it is desirable to have a dead finish. On account of the annoying reflections from ma-

chinery, it is often desirable to paint or otherwise dead-finish such parts as practicable, in a neutral tint.

(6) The cost of the lighting equipment and the cost of maintenance must of course be taken into account in considering the ultimate economy of lighting. Both of these factors usually receive most careful attention on the part of the manager of the industrial plant, but curiously enough, the important collateral question of loss of light due to accumulation of dust and dirt on lamps, globes, shades and reflectors, is often overlooked or underestimated. It is no uncommon thing in industrial lighting to find this loss as high as 30 per cent to 40 per cent, which taken in the aggregate, means millions of dollars a year wasted annually the country over, because of failure to keep the lamps, etc., moderately clean.

(7) Any system of lighting which requires more or less frequent handling of individual lamps by the workman to adjust the location of the light with reference to the work, is likely to be costly in operation, in that it consumes the time of the workman and distracts his attention. There are many industrial establishments in which the operators adjust the height and angle of the lamps to suit their individual tastes. Each operator adjusts the position of his lamp close enough to his work to give an illumination which is satisfactory to him. As a result of this practice it sometimes happens that the operator, in order to secure suitable illumination on his work, may so adjust the lamps that part or all of the light therefrom shines directly into the eyes of the neighboring workman, thus impairing the efficiency of the latter. The general plan of permitting each individual workman to act as his own "illuminating engineer" is on its face open to severe criticism, though it is difficult to convince some industrial-plant managers of the need of throwing over this heritage of old-time European shop-lighting practice.

(8) There is ultimate economy in providing good general illumination throughout the workroom to prevent or minimize accidents. The insurance companies' records show in a most convincing way that the greatest number of accidents in industrial plants occur during the months of diminished daylight. With artificial light, where the difficulties in securing good diffusion are so much greater than they are by daylight, the consideration of ample lighting as a means of preventing accidents to the workman should have great weight.

The very common system of strictly local or spot lighting is undoubtedly responsible for loss of life and limb and from this point of view should be regarded by the industrial-plant manager not only as uneconomical, but inhumane.

William C. Redfield, in a recent address on "The New Industrial Day," expressed the view that the great body of our industries is not abreast of the times in that the human element in production is not treated in the intelligent manner in which the mechanical element is treated. The degree and kind of efficiency which is sought and got from the machinery as such, is not got from the workman because of failure to fully appreciate the fact that the workman differs from the machines in being run by his own motive power, which is responsive and vital and not inert, and which under right conditions, can be rendered the source of continuing and increasing profit to all concerned. The industrial-plant manager who is abreast of the times, fully realizes that one of these "right conditions" is the provision of good lighting.

Supply of Energy for a Large Community.

The first of a series of daily meetings to discuss various phases of the problems bearing on the systematic development of all the transportation facilities in the city of Chicago, was held at noon on May 23, by the City Club of Chicago. The speaker on this occasion was Samuel Insull, president of the Commonwealth Edison Company, who gave an illustrated talk on "The Supply of Energy for a Large Community."

Mr. Insull called attention to the great reduction in coal consumption per unit of energy generated that has resulted in the last score of years from the increase in size and efficiency of steam-driven electrical generating equipment; this should be credited as a decided factor in the conservation of natural resources. Since 1886 the cost of electrical energy for light has been reduced 69 per cent in Chicago, and it is possible now to secure nine times as much light for one dollar, due partly to the greatly increased efficiency of incandescent lamps. These facts were shown graphically, also the great increase in output developed and taxes paid by the Commonwealth Edison Company, the division of its gross income, etc. It was pointed out that the total investment in the electric light and power, gas, telephone, street and elevated railways of Chicago aggregates about $450,000,000 to $500,000,000, which is exceptionally low for the great income of these utilities.

The speaker declared that the power requirements of the present steam railroads within Chicago are relatively small compared to the total power requirements of the entire community. He showed why it would be inadvisable for these railroads to establish separate power houses when electrification is brought about. The investment required for this would be very much greater than if the energy were purchased from the established central-station system, there would be an entirely unwarranted duplication of plants, substations, transmission and distributing systems, and moreover the load-factor of the separate plants would be poor.

Mr. Insull showed by means of several typical load curves the division of the output of the Commonwealth Edison system into the railway and lighting and power classes of service, and pointed out that the great diversity of this service with noncoincidence of the peaks from the individual classes, particularly the wholesale supply of energy to elevated and surface electric railways, accounted for the exceptionally high load-factor of the Chicago system. On one day last February this reached a value of 55.7 per cent. By contrast, the load-factor of the New York Edison system was about 44 per cent because it does not have so large a proportion of supply to wholesale consumers.

The Chicago central-station system supplies as much energy as the central stations of New York, Brooklyn and Boston combined. This, together with the high load-factor, enables the Commonwealth Edison Company to supply energy to small consumers in Chicago at a lower rate than in any other similar large city in the world. Mr. Insull compared the conditions regarding energy supply and energy costs prevailing in the city of Chicago and the county of London. Despite the fact that the population of the latter is nearly seven million and there are some 60 central stations supplying this multitude, the energy supplied by the one central-station system to the two million inhabitants of Chicago is nearly 50 per cent greater.

Mr. Insull concluded his address by pointing with just pride to the great results accomplished by his company as showing what can be done by a well managed monopoly of the generation and distribution of energy. If high efficiency and low cost are to be attained in that industry they can only be obtained by such a monopoly, which insures to the energy consumers the securing of these benefits and at the same time a decent return to the investors. Mr. Insull did not care what interests controlled the monopoly but he was positive that the cheapest power can be obtained only in this manner.

The Illumination of the Home.

By F. A. Vaughn.

In the illumination of the home the illuminating engineer comes in closer contact with the personality of his client than in any other class of installation. The results will, consequently, be all the more critically considered, the more highly appreciated and the more lastingly beneficial; for if he succeeds in providing an artistic and efficient installation which will be pleasing and comfortable and conserving of the eyesight of the younger as well as the older members of the family, the accomplishment must receive the closest attention of all concerned. There is no place in which artificial illumination is used, except perhaps in the schools, where more real vision conservation can be accomplished for future generations by the illuminating engineer, than in the home, where the habit of reading practiced by all members of the family and the necessity for diligent study by "lamplight" on the part of the younger ones, has developed to such an astonishing degree with the advancement of our civilization. In the home every member of the household justifiably feels at liberty to view critically anything affecting his daily comfort and health, and each condition surrounding the individual needs can be advantageously studied, whether they be those of the cook in the kitchen; the boys and girls at their study table; the society debutante at her dressing table; the mother with her sewing or the father in the library. The various requirements of residence illumination should therefore be thoroughly considered, and, if modern equipments are available to satisfactorily cover them, a result of far more importance than has been accorded the subject in the past, can be secured.

Before entering the residence there is required an inviting efficient illumination of the entrance, porte cochere or porch. The comfort and safety of visitors and residents are much enhanced by proper illumination of the entrance and stairways leading to the house, especially in winter. This condition approaches the problem encountered in street lighting, or the illumination of other exterior spaces, and the unit which will efficiently cover the required area, with the source well screened from vision so as not to make the approach uncomfortably dazzling, is best. A lantern type of unit with opalescent sides and with the light emanating from the open bottom, with properly designed and located incandescent-lamp reflector, can be utilized for this purpose, or a dense diffusing ball, if efficiency is not paramount, may accomplish the desired result in a manner almost as pleasing.

Fig. 1.—Front Library.

In the vestibule a relatively small amount of warm, attractive illumination is desirable. Sometimes mechanical problems arise here, such as small clearance between the top of the door and ceiling. A condition of this kind may be overcome by placing the unit in a depression in the ceiling and by the employment of a directive reflector projecting the light through a plate of diffusing glass placed in a flat frame which can be made to project from the ceiling as small an amount as desired. In the residence described in this article, a mirrored glass reflector, with socket and lamp, were recessed in the vestibule ceiling and a piece of hammered, smoked amber glass, sand blasted on one side, was framed in oak to correspond with the interior woodwork, the glass being similar to the art glass shown in the bookcases in the library. This produces a pleasing warm light of sufficient intensity for the purpose.

It hardly seems necessary to discuss the fact that what is required in the interior of a home, from an artistic, physiological or a psychological standpoint, is comfortably sufficient illumination, for the requirements of the particular room under consideration, without the accompaniment of glare from the individual units or from an over abundance of illumination. This requirement can, of course, be fulfilled in different ways, any one of which may be chosen according to the artistic taste of the client, or the engineer. In the particular installation under consideration, the features of the indirect system of illumination were mainly utilized throughout the installation, with localized and intensified illumination in a very few places. By this means, effects may be produced possessing the characteristics of warmth, uniformity, comfort and comparative freedom from shadows. It is evident that pleasing results might also be obtained through the medium of illumination of almost opposite characteristics, treating the problem by means of localized, thoroughly shielded and diffused, direct illumination, by means of properly constructed and designed table lamps and other types of units. It is however, undoubtedly more difficult for the engineer to obtain equally satisfactory and pleasing results by the latter means, as the proper design and

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It hardly seems necessary to discuss the fact that what is required in the interior of a home, from an artistic, physiological or a psychological standpoint, is comfortably sufficient illumination, for the requirements of the particular room under consideration, without the accompaniment of glare from the individual units or from an over abundance of illumination. This requirement can, of course, be fulfilled in different ways, any one of which may be chosen according to the artistic taste of the client, or the engineer. In the particular installation under consideration, the features of the indirect system of illumination were mainly utilized throughout the installation, with localized and intensified illumination in a very few places. By this means, effects may be produced possessing the characteristics of warmth, uniformity, comfort and comparative freedom from shadows. It is evident that pleasing results might also be obtained through the medium of illumination of almost opposite characteristics, treating the problem by means of localized, thoroughly shielded and diffused, direct illumination, by means of properly constructed and designed table lamps and other types of units. It is however, undoubtedly more difficult for the engineer to obtain equally satisfactory and pleasing results by the latter means, as the proper design and

construction of the latter class of units are far more problematical than with the former.

In the library, Fig. 1, there are, of course, several conditions to satisfy, the main one being, however, satisfactory illumination for reading and study. In the installation here described an indirect unit in the center of the room furnishes the entire general illumination and contains a maximum of four 60-watt tungsten lamps, two of which are ordinarily used, the third and fourth being utilized through the medium of a rotary type of push-button switch. The illumination of the music on the piano is also accomplished ordinarily by this unit, the special feature in connection therewith being that no disturbing shadow is cast upon the sheet of music or keyboard although the unit is directly behind the performer. With a direct unit in the same position it was impracticable to utilize the direct illumination from the center of the room on account of the shadow of the performer's head. For artistic reasons and for economical use there are also provided on the piano two craftsman, newel-post type of units equipped with one 30-watt lamp each, diffused by sand blasting and the use of art glass similar to that described previously. This arrangement furnishes sufficient local illumination for the use at the piano without the use of the central unit.

In the living room, Fig. 2, an indirect type of unit is also employed with practically the same arrangement as in the library, the customary use of this unit being also quite similar.

There are, however, as shown in this illustration, utilizable two local units, of the craftsman design, one on the small table at the head of the couch and one portable floor type which may be used at the couch or elsewhere in the room.

The dining room in the residence may be treated in at least two distinctly opposite ways, one of which will localize the illumination on the table, allowing only a comparatively small amount of soft illumination for general purposes. This may come entirely from the reflection from the table covering, or it may be allowed to emanate from the lighting unit through the opalescent glass of which the unit may be composed or both methods may be used. The other way would possess the feature of more uniform general illumination and would be exemplified by the indirect system. The former method was chosen in this case for specific reasons of no particular interest in this article. In Fig. 3, the unit utilized was designed with special consideration of the faults which usually characterize units of this character, and the form of unit is such and its height above the level of the line of vision of those seated at the table is so arranged relative to the position of the lamps and reflecting medium that it is practically impossible to receive light on the retina, directly from the source, regardless of any normal position one may assume at the table. The features of a design of this character, it is believed, eliminate the very serious objections to this type of unit and allow those who wish to take advantage of the localized illumination which may be considered desirable to use in connection with the cut glass and silver, to do so. This unit contains three 25-watt, round-bulb, frosted lamps, situated well up in the crown of the unit.

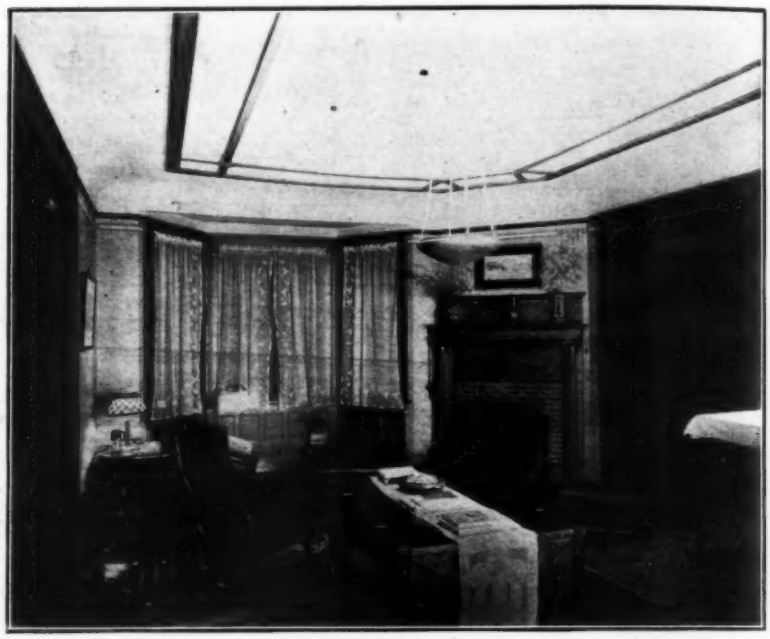


Fig. 2.—Living Room.

In the study, or lounging room, seen through the door in Fig. 3, indirect illumination is also utilized for general purposes. As this room is decorated largely in Japanese style, the localized illumination provided here

Fig. 3.—Dining Room.

is produced by two units designed from a pagoda form of lantern in which a dense, diffusing, open reflector of the intensive type is placed and by means of this and small round bulb lamps the light is directed from the bottom of the pagoda on to either end of the couch, or window seat, where reading, or studying, may be carried on. In a room of this character, owing to the artistic and decorative features desired, efficiency must be somewhat subservient, if required. It is believed, also, that well-diffused illumination very largely minimizes the effect of glare from a reading page so that these local units are only for incidental use.

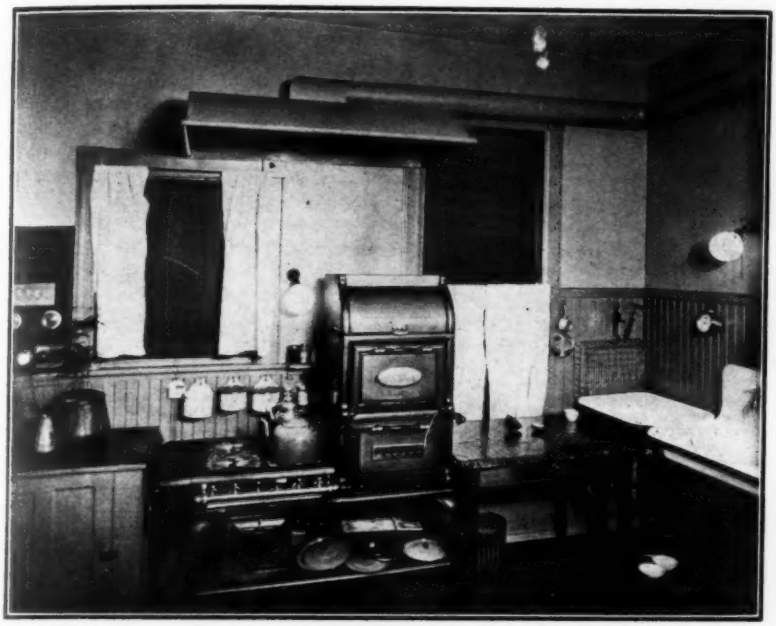


Fig. 4.—Kitchen.

In the kitchen, Fig. 4, the general illumination is provided from the center of the room by means of an extensive form of prismatic glass reflector with a 25-watt tungsten lamp and placed on the ceiling. In addition to this, however, localized illumination is provided over the sink and over the gas range by means of a unit equipped with a 25-watt tungsten lamp, pull chain socket, and dense, diffusing glass ball. Sufficient flexibility is provided in this manner to satisfy the conditions, or requirements, arising for varying quantities of illumination and the requirements of economy as well.

Fig. 5.—Bed Chamber.

For use in passages and hallways it is, of course, not necessary to obtain more illumination than is required for the mere safe passage through the space. It is possible therefore to illuminate spaces of this character by units which are equipped with tungsten lamps of comparatively low wattage, the units utilized in the largest halls in the installation under consideration being equipped with one 40-watt lamp. By means of three-way switches or their equivalent the indirect units in the upper halls and passages are controlled from both upper and lower floors.

In the chambers there are, of course, many varying conditions and requirements arising, which depend largely upon the temperament of the occupant of the chamber. Where localized illumination on the mirror is imperative on account of the demands of the female members of the family, it may be difficult to provide satisfactory illumination economically from any single unit placed in the center of the room. A direct type may cause undesirable shadows on the dressing table, or mirror. The indirect type may be unsatisfactory from the standpoint of providing sufficient intensity at the distances ordinarily required to be used between the center of the room and the dresser. An adjustment, however, of the length of suspension chains may enable this to be accomplished satisfactorily, although it may be desirable, if not necessary, to utilize localized illumination on the dresser table if the individual requirements demand it. The rooms occupied by the children, especially the boys, are, however, quite satisfactorily illuminated by either system without any particular difficulty. In Fig. 5 is represented a typical chamber in the installation under consideration. A 25-watt tungsten lamp is utilized in the unit shown in this room.

In the bathroom, Fig. 6, general illumination is furnished by an indirect unit containing a 25-watt tungsten lamp which on account of the light walls and furnishings is particularly efficient in its production of illumination. If it is desired, however, for tonsorial or other purposes, to utilize local illumination a 25-watt tungsten lamp, with pull chain socket, and dense diffusing globe has been provided above the mirror in such a position as to reflect the light upon the face with

as little interference from the glare of the unit as possible. In the bathroom, base-board, indicating outlets may be provided for electric radiators and wall outlets for the utilization of water and curler-heating and vibratory-massage apparatus.

In the basement and exterior spaces such as sleeping porches, units usually of the smallest size and simplest form can be utilized on the ceiling with opaque, or glass, directive reflectors as desired, their control being such that they may be lighted from any floor desired, and, where the unit is remote from the switch, it is advantageous to install a signal, which, on alternating-current systems, by a slight buzzing noise notifies the client if he has neglected to turn out the remote unit in question.

It is undoubtedly beyond the scope

Fig. 6.—Bath Room Showing Shaving Unit.

of this article to enter into the many auxiliary features connected with the wiring of the residence but mention of a few points may not be out of place. For instance, ample facilities should be provided in the way of base-board receptacles for the utilization of any apparatus such as table or portable lamps, electric fans, cigar lighters or other useful appliances, especially in the dining room where cooking utensils may be used.

In general, effects striven for in the described installation were sufficient illumination of a considerable degree of uniformity throughout the rooms, with consistent gradations from room to room according to the manner of their utilization. These effects, it is believed, are those generally desired in the home.

As the lower floor in this illustration is in fact one continuous series of rooms opening from one to the other, illuminometer readings taken along the center line of the rooms from the front to the rear of the house and plotted on a system of co-ordinates will give the curve of illumination in a plane passing practically through the center line of the units. From the curve, Fig. 7, it will be seen that

TABLE I.

Room	Area in Square Feet.	Number of Lamps.	Watts.	Average Intensity in Foot-Candles.
First Floor—				
Front library	195	4	240	2.43
Living room	280	4	240	1.26
Living room	280	3	180	0.95
Living room	280	2	120	0.61
Dining room*	180	2	60	1.57
Study	85	1	150	1.68
Second Floor—				
Front hall	—	1	40	0.13
Bed chamber	223	2	120	0.95
Bath room	48	1	25	0.73
Bath room**	48	2	50	1.94
Bed chamber	165	1	100	1.47
Bed chamber	116	2	65	1.23
Bath room	50	1	40	0.67

*Direct illumination from dome over table.
**Direct illumination from shaving unit superimposed on indirect.
Note: Measured intensity of illumination on plane 18 inches from shaving unit is found to be 10 foot-candles. This test was taken on the plane of the face in the shaving position.

a maximum intensity of approximately three foot-candles of horizontal illumination is secured in the library, which in the living room is reduced to approximately 2.5 and in the dining room, where the intensity of general illumination is subsidiary to the localized illumination on the table, it is again reduced to approximately 1.3 foot-candles, with practically the same quantity in the study, where also localized illumination is utilized for special purposes.

In Table I will be found some engineering data on this installation, which, however, could not include sufficent detail to give a complete survey of the space illuminated, and it should be noted that a general impression of uniformity is received by an inspection of the lower floor, while, of course, the actual readings of the illuminometer show the true values, as far as cited.

Throughout an installation of this character considerable attention should be given to the blending of the artistic and the engineering sides of the problem, especially by the selection of the decorations in such a manner as to provide sufficiently efficient reflecting surfaces on the ceiling, where required, but with the idea of keeping the color of the walls, especially the portions which come within the natural angle of vision, subdued in tone and color to an extent which will eliminate the depression of visual function by glare or specular reflection from their surfaces. It is, of course, not necessary to reduce the coefficient of reflection of the walls to the point of dinginess in order to secure this effect, but sufficient consideration of this point will result in the selection of tints and colors which may at once be satisfactory to the illuminating engineer and still fulfill the artistic requirements of the client.

The finish and artistic design of the units should, of course, also receive mature consideration, as harmony in

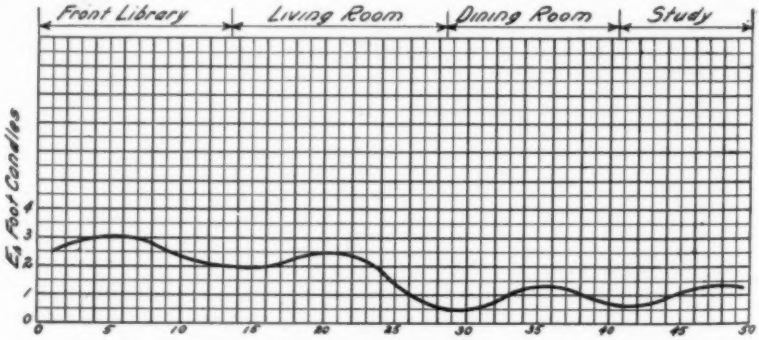


Fig. 7.—Horizontal Distance in Feet Along Center Line of Rooms from Front to Rear of Residence.

shape and coloring can be secured by conscientious endeavor.

Throughout any installation of this character it is believed the two main objects to bear in mind are the production of sufficient illumination without excessive expenditure of electrical energy and the accomplishment of this result without interference with the artistic features and comfortable use of the illumination.

Electric Lighting in the Argentine Republic and Brazil.

By J. W. Tabb.

To the majority of people in this country the trade opportunities in South America that are open to American manufacturers and the conditions which determine our foreign relations there are but little known. That these opportunities in South American countries have hitherto been neglected is doubtless due, in a large measure at least, to the rapid expansion of domestic commercial activities. The few companies who have realized the possibilities of this market, and in which by persistent effort have created a demand for their goods, have frequently built up a business which rivals in its extent that conducted by them at home. Statistics bear out this fact since the difference in value between the export and import trade of the United States with the Argentine Republic alone in 1910 amounted to over ten million dollars in favor of the former.

As it is the writer's intention, however, to deal mainly with the question of lamps and illumination in Brazil and in the Argentine, only a brief summary of the various conditions affecting trade in these two countries will be mentioned, and this only in order to assist the reader in obtaining a clear understanding of the lamp situation.

In the first place it must be noted that the Spanish of South America can hardly be called the Spanish of Spain. Just as these countries of South America have advanced more rapidly than the mother country, so has language changed, combining words and phrases adopted from the Italian, French, English and, in some cases, from the native Indian tongue. The knowledge of Spanish is necessary for successful business, for he who transacts business receives a more cordial reception than he who must converse through a third person. All dealings with the government must be in Spanish. It may be said that no matter how clumsily a foreigner jumbles the rules of grammar and pronunciation, he will find that his listener never smiles, a fact which could hardly be said to be a trait of the Yankee.

The Argentine Republic.

The Argentine Republic consists of 14 provinces and 10 territories, which cover an area of 1,135,000 square miles. While this in itself is not so impressive, still, if it is considered in comparison with some of the European countries, the size of the republic will be noteworthy, e. g., within the borders of this republic may be placed Germany, France, Great Britain, Italy and Switzerland and still leave room for Germany and Great Britain to be included again.

Climatically this country presents the great contrasts which might be expected in so vast an area, ranging as it does through 34 degrees of latitude. The summer weather of the extreme north of the Argentine corresponds to the summer weather of Florida, while that of the extreme southern part is subject to the same conditions that exist in northern Alaska. The city of Buenos Aires has the same climatic conditions as Memphis, Tenn.

There are no elevations of note in the Argentine, the great plains stretching from the Atlantic Ocean to the foot of the Andes. This fact has both advantages and disadvantages. It gives facilities for river transportation and the building of roads and railways, but it makes impossible the development of waterpowers except in regions remote from commercial use. Only in the northern Argentine is there an abundance of wood for fuel and unless unexpected supplies of coal or oil are discovered, the country can not be expected to become important from a manufacturing standpoint.

The population of the Argentine Republic is over 6,720,000 of which 1,247,000 live in the city of Buenos Aires, the capital of the republic. In 1910 this city ranked sixth in size among the cities of the world. The other principal cities of the country are: La Plata, 80,000; Cordoba, 60,000; Tucuman, 55,000; Rosario, 150,000; Parana, 30,000; Santa Fe, 33,000; Mendoza, 51,000; Bahia Blanca, 37,000; Corrientes, 20,000. The main sea ports are Buenos Aires, Rosario and Bahia Blanca.

Some years ago the leaders of the Argentine Republic clearly recognized that in order to advance they must secure foreign aid. The result is seen in the growth of communication within the Republic, the establishment of banks, the lighting and power plants, and many other public improvements, until today in the place of a small ill-kept town rises the well-built city of Buenos Aires, whose foreign trade has sprung from a total of $215,000,000 in 1895 to $700,106,623 in fifteen years. At the same time the financial conditions have been placed upon such a firm basis that today the currency does not fluctuate to any marked degree.

Turning now to the question of lighting, we will consider first, the conditions prevailing in the capital, Buenos Aires. At night this city has one

Avenida Central, the Principal Street of Rio de Janeiro.

Busiest Section of the Avenida Central.

prominent characteristic which would not be noted in any of the cities of the United States; namely, its thoroughfares, whether main streets or side streets, are well illuminated; in fact, it is almost impossible to find any dark spots in the streets.

Most of the street lighting is accomplished by means of inclosed-arc lamps placed in the middle of the street and suspended by means of wires stretched across the street. In the Avenida de Mayo, the main street in Buenos Aires, standards containing three arc lights are located along the center of the avenue, while staggered between these at the sidewalk are placed standards containing one lamp. In the suburbs are found more cases of incandescent street illumination. In most instances the lamps are of German make. The majority of railroad stations are illuminated by means of incandescent lamps. Nearly all the residences which have been built within the last few years are equipped for electric lighting.

In Buenos Aires one finds both the Phillip and the Osram lamp used. In a few instances, however, the "Mazda" lamp may be seen, but as this lamp has not been extensively advertised nor very vigorously pushed, it has not received its share of attention in the Argentine Republic. The preference given to the German and English lamps may be attributed to the fact that there are not more than five hundred Americans in this city, as compared to nearly five or ten times that number of English and German, who naturally turn to products from their home country whenever possible.

Among the largest users of incandescent lamps in the Argentine, as in all other countries of South America, are the moving picture theaters. On nearly every street one of these places of amusement, at least, is to be found. They are expensively fitted up, and in most cases the front is more artistically illuminated than that of similar theaters in this country. There is usually a room in these places where the general public wait before entering the room where the pictures are shown until the film which is being displayed is finished. Usually this waiting room has an orchestra. The general scheme of lighting followed always tends to give too much light in the waiting room, and not enough attention is paid to the requirements of effective illumination, in fulfilling which the excessive glare so prominently a characteristic of the lighting would be eliminated.

To show that the United States has still a large field here for electrical goods, the following statistics may be quoted.

Of the $4,216,000 worth of business represented by electrical supplies imported into Argentine in 1909, the United States secured only eleven per cent, while Germany secured thirty-four per cent. There were imported into Argentine in the year 1910 over three million incandescent lamps.

Brazil.

Turning now to a consideration of Brazil, the largest of the South American republics, a few general remarks regarding the climate, as well as business conditions, may be in order.

The Republic of Brazil, extending over an area of 3,216,130 square miles, is larger than the whole of the United States, including Alaska. Its size is more forcibly impressed on one if the extent of the country were measured by the time it takes to travel from one point to another, within its boundaries. The railroad facilities are very poor, and for that reason practically all transportation is carried on by means of water.

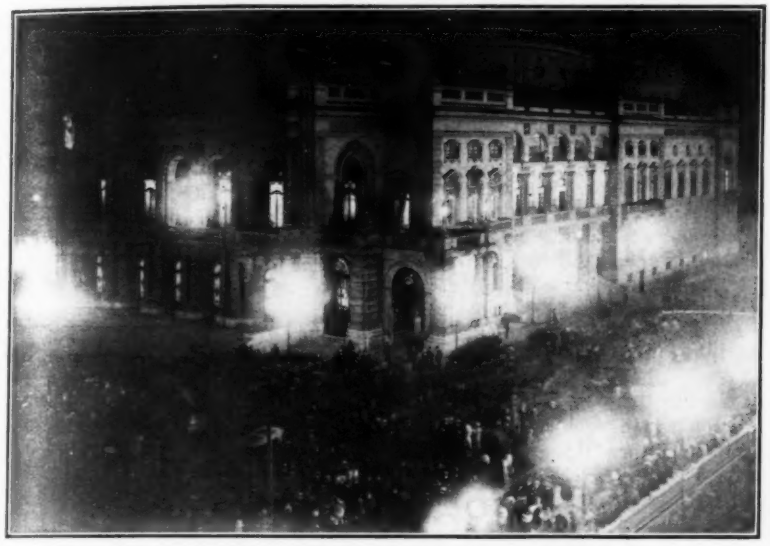
The climatic conditions prevailing in the various parts of Brazil differ according to the location; the northern part of Brazil has the hot temperature of the tropics, while the central and southern parts have warm days and cool nights. The rain-fall in the northern part is excessive.

The population of this vast region is varied in the extreme, and contains people of every grade of civilization. The population is in the neighborhood of 21,000,000, fifty per cent of whom are whites, scattered along the coast line; the interior is inhabited only by semi-civilized people. The principal cities, with their estimated population, are: Rio de Janeiro, 1,000,000; Sao Paulo, 400,000; Sao Salvador, 350,000; Belem, 200,000; Recife, 150,000; Porto Alegro, 100,000; Ceara, 50,000; Manaos, 50,000. The other cities with a population of more than 20,000 are: Bello, Horizante, Campinas, Corumba, Curityba, Cu-

Grand Staircase in Municipal Theater, Sao Paulo.

yaba, Florianopolis, Maceio, Ouro Petro, Parahyba, Petropolis, Sao Luiz, and Victoria.

For the first time in the history of Brazil, the grand total of the country's foreign commerce in 1910 exceeded



Night View of Municipal Theater, Sao Paulo.

$500,000,000, a sum greater by far than that of any other of the South American countries, except the Argentine. The increase in 1910 over preceding years is due almost entirely to an increase in imports, which amounted to over $235,000,000. Practically all countries share to a greater or less extent in this general increase, the United States having an export trade with Brazil of over $8,000,000, $460,000 of

Store Illumination in Brazil.

which was devoted to electrical machinery and apparatus.

There has been a growing demand in Brazil for all kinds of electrical supplies. The United States furnishes approximately fifty per cent of this trade while Great Britain and Germany furnish the most of the remainder in about equal shares.

The larger cities have adopted general lighting by means of electricity, but many of the smaller towns still use gas, although they are rapidly changing to electric lighting. The city of Rio de Janeiro is illuminated by enclosed arc lamps. There are 91 separate circuits, having a total of 5,200 lamps. These lamps take 7.5 amperes at from 72 to 75 volts. There are a few installations of flaming arc lamps but as yet no installations of incandescent lamps are used in street illumination.

The entire electrical service of the city is controlled by the Rio Light & Power Company, a corporation financed by American and Canadian capital. The lighting load is in the neighborhood of 15,000 kilowatts, but this is rapidly increasing, due to the great demand for electricity. The company, while operated by Canadian capital, has Americans for its high officials and therefore the tendency is to favor American goods. All of the electrical machinery is of the General Electric make.

The power is brought from Rio des Lagos, a distance of fifty-six miles. Here it is generated at 6,000 volts, and is transmitted to the city at a pressure of 45,000 volts. It is then stepped down to 216 and 120 volts at various stations located in different parts of the city. The arc lights are operated from constant-current transformers, some of which are air and some oil-cooled. All private installations are of low tension. Almost all of the wiring is underground.

The public lighting of Rio costs the government 7.7 cents per kilowatt-hour for a minimum of 5,000,000 kilowatt-hours, while private lighting costs in the neighborhood of 13 cents per kilowatt-hour. If the power consumed by the government amounts to over 7,000,000 kilowatt-hours a different rate is charged, while for any excess over 10,000,000 kilowatt-hours the rate is still lower. The concession to the companies for private lighting terminates in 1915, and for public lighting in 1945. The company must furnish, renew and repair all apparatus and bear expense of laying cables and the like. The city receives from the company $48,000 a year for fiscalization and inspection. All charitable and educational institutions receive a reduction of twenty per cent.

The main street of Rio, the Avenida Central, stretches diagonally across the main business section of the city, and is, without doubt, one of the best illuminated streets in the world. This avenue is about 100 feet wide and has in the center isles of safety, where one may stop, in crossing the street. Upon these places of refuge are placed standards containing three arc lamps, spaced about 100 feet apart, while upon each sidewalk, between these, are placed gas standards with five burners furnished with Welsbach mantles. Upon the side streets arc lamps are suspended in the middle of the street by means of wires attached to the building on each side, and staggered with these are

Waiting Room in Theater, Sao Paulo.

gas standards, often with two or three burners. There are no incandescent street lights in the city, but it is expected that in the near future, there will be some installations of these in the suburbs. Nictheroy, which is across the bay, is illuminated mainly by means of incandescent street lamps, but they are not placed very close together, so that the general appearance is not particularly striking.

Sao Paulo, the second largest city in Brazil, and at the same time the richest, is lighted by means of inclosed arc lamps, suspended in the center of the street. The general illumination of this city is not quite as effective as that of Rio de Janeiro, but is nevertheless very good. There have been used in this city a number of different types of street lights, none of which have proved satisfactory, and it is expected that incandescent lamps will soon be used in all street illumination. The greatest competitor of electricity in this city is gas, under high and fairly constant pressure, and the prices are not exorbitant, as is the case in Rio. The suburbs of Sao Paulo are lighted entirely by electricity, since gas is not available in this section. There are a number of Mazda incandescent street lamps used in these parts of the city.

In regard to store lighting, it is of a rather mixed nature, as many of them use both gas and electricity. Many of the larger stores use gas arcs of from two to five burners for general interior illumination, while the show windows are illuminated by means of incandescent lamps. Outside of the window is often placed a large arc lamp, which rather spoils the effect of the window display. The store Casa Fuchs is referred to as the best example of incandescent lamp lighting. Here the main part of the store is lighted by means of 250-watt Osram lamps while in the show windows 100-watt and 60-watt Mazda lamps with Holophane reflectors are used. Another store which is considered to be a good example of lighting is the Casa Allema. Here inclosed arcs of the Thomson-Houston type are used for general store lighting, while Mazda lamps in Holophane glass hemispheres are employed in the window. Many of the small stores use 60-watt Mazda lamps. One thing is noticeable in all illumination throughout Brazil, viz., the absence of frosted lamps. It is stated that it seems almost an impossibility to get the general public to use frosted lamps as they feel they are losing too much light by so doing.

The majority of the hotels use carbon lamps for illumination. The Hotel Majestic, which is considered the best in Sao Paulo, uses in the dining room carbon lamps placed on the side walls, while down the center suspended from the ceiling are inclosed arc lamps. The fact that the power company supplies free renewals of 32-candlepower carbon lamps keeps the hotel proprietors from using metal-filament lamps.

Avenida Paulista is the best illuminated street in the city. It extends through the residence section in which are many houses of artistic architecture. All houses are made of a sort of Brazilian asphalt, a material which makes it rather difficult to wire a house after it has once been constructed. Most of the homes in this locality are illuminated by means of incandescent lamps, and while no definite number of installations can be given, it is estimated that the number of lamps used in residence lighting only is about 90,000.

Turning for a moment to the different styles of illumination, a few items regarding some peculiar conditions may be noted. The moving-picture theaters of Brazil are more elaborately illuminated than those in the Argentine. They usually have a small waiting room, spoken of before, and this room is all ablaze with light. The lighting bill of one of these moving-picture theaters in Sao Paulo amounts to over $300 a month. The front of the building is usually covered with light if any special social function is taking place. The railroad stations, theaters and halls, as a rule, have too much light.

In conclusion, it might be said that in both the Argentine and Brazil, the general methods followed in illumination seem to indicate that considerable light is required. No definite rules for illumination are followed, and consequently often a glare results from the use of too many or too large units in small installations. These countries both offer a good opportunity for the American manufacturers, if they will take advantage of it in the proper way, and not expect to reap too great rewards the first year. If they study the situation and are content to start with small profits, they will be able in time to develop this market and build up a trade of no mean importance.

Announcement of Dates for New England Section Convention.

The fall convention of the New England Section, National Electric Light Association, will be held in Boston, Mass., October 10 and 11, 1912. A very interesting program is being arranged by the secretary, Miss O. A. Bursiel.

International Rubber Show.

An exhibition of rubber and its products will constitute the third international Rubber and Allied Trades Exposition to be held at the Grand Central Palace, New York City, from September 23 to October 3.

Symposium on Street Lighting.

A meeting of the Chicago Section of the Illuminating Engineering Society was held on the evening of May 23 in the rooms of the Western Society of Engineers, Chicago. The election of officers for the ensuing year was the first matter taken up. This resulted in the choice of the following named gentlemen: chairman, W. E. Barrows, Jr.; secretary, J. B. Jackson; managers, F. A. Vaughn, S. E. Church, J. R. Cravath, J. W. Foster and E. Wray.

The main business of the evening consisted of a symposium on the subject of street lighting, which has received considerable attention in Chicago recently because of the decision of the city authorities to use flaming-arc lamps throughout practically the entire city.

The program was opened by T. H. Aldrich, who read a paper reviewing the subject in general. He discussed the three prime reasons for having street lighting, which he considered to be (1) a means of making traffic safe on the street, (2) a police measure to prevent crime, (3) a means of bringing out the architectural beauties of the buildings along the streets. He considered daylight to be the best criterion as to the color value of the light that should be provided. Uniformity of illumination and good diffusion are imperative. Mr. Aldrich discussed the characteristics of the various types of arc lamps used for street lighting. He gave the height of suspension for each type of lamp and the relative advantages and adaptability of each class. Taking up incandescent lighting, he similarly discussed the cluster system and also the street series system using tungsten lamps.

A contribution from Clayton H. Sharp, of New York, was then read by Mr. Aldrich, in which Dr. Sharp commented on street lighting conditions prevailing in Europe. The foreign cities have been quick to adopt the high-efficiency lamps, particularly for important streets. He found relatively little use of tungsten or of magnetite lamps. The series system is seldom used. Illuminometer readings that he had taken along some of the prominent streets in Berlin, Paris and other cities were given. These showed that there is a very much better uniformity of illumination than prevails in most American cities. The ratio of the maximum to the minimum illumination varied between 1 to 1 and 9 to 1.

The next contribution read was that written by P. S. Millar, of New York, in which he contrasted civic and display street lighting. The first is primarily a police measure. The second generally is a commercial proposition

and has been very frequently misnamed "ornamental" street lighting. It is curious to note that the latter usually is found in those cities where the civic lighting is very inadequate. Mr. Millar believes that a greater height of mounting is generally desirable, even for incandescent equipment. From his own observations he has found that the practice of staggering the lamps on both sides of the street is not so good, as regards uniformity of illumination, as having all lamps on one side only.

S. L. E. Rose, of Schenectady, N. Y., read a contribution submitted by G. H. Stickney, of the General Electric Company, on ornamental street lighting by tungsten clusters. This movement, which has become general in many parts of the country, was originated chiefly by merchants and city boosters and later fostered by those who have current or equipment to sell. The cluster system has generally been installed regardless of engineering principles. However, the results have been quite good and the lighting effect is usually in harmony with the window lighting along the business streets. Mr. Stickney considers that the use of single and larger tungsten lamps would be much better from the standpoints of initial cost, efficiency and maintenance. Moreover, he thought that the esthetic effect would be more pleasing than is found when groups of four or five lamps are used in the cluster arrangement. To illustrate these ideas a large number of slides of streets illuminated by the cluster system were shown.

Mr. Rose then gave a talk on the use of arc lamps for street lighting which he illustrated by a large number of slides of the various types of lamps now used, distribution curves and views of streets illuminated, particularly with magnetite lamps. He had strong praise for the ornamental type of this lamp.

E. L. Haines, assistant city electrician of the City of Chicago, gave a review of the tests which had been made prior to the selection of the type of flaming-arc lamp now being installed in Chicago. These were conducted for a considerable interval of time with several types of flaming lamps which were mounted at different heights and equipped with different forms of inclosing globes. It was found that without an outer globe a very pronounced glare resulted, which made it imperative to use a diffusing globe of some kind, even though the use of this resulted in a material decrease in the efficiency of the lamp. Three types of inclosing globes were tried out; these were Alba, medium alabaster and a medium opalescent. Since the first of these gave the highest efficiency, it was selected. These globes cut down the intrinsic brilliancy of the lamp to about the same value as is found in the Wellsbach mantle which was considered as safe. The tests made with different mountings showed that the 30-foot height gave the lowest ratio between maximum and minimum illumination along the street, both as regards horizontal and normal illumination. The uniformity with the high suspension being very decidedly better, it was decided to make use of it as far as possible, and the lamps are, therefore, being mounted at the height of 25 or 26 feet wherever this is possible. In some instances heights of 20 or 21 feet are necessary. Underneath elevated railways, the same type of lamp is being used but a denser outer globe is employed to cut down the brilliancy and increase the diffusion.

At the close of the formal papers that had been presented, the discussion was opened by H. E. Ives, who commented on some of the conditions that he had found on a trip to Europe a year ago. Dr. Ives considered the street lighting in Naples, Italy, to be about as good as any he had seen. There high-candlepower lamps are strung in the middle of the street at a considerable height, and as the buildings along the street are mostly white or buff-colored, the light is very completely reflected and seems to fill the entire street with a highly diffuse illumination.

J. B. Jackson briefly abstracted some parts of the report of the Committee on Street Lighting, which is to be presented at the coming convention of the National Electric Light Association. Herein it is strongly urged that each case be considered fully with regard to the conditions prevailing, and that it should receive the treatment appropriate for those conditions. No general rules can be laid down for all street lighting. Mr. Jackson also read a communication from S. G. Rhodes, of the New York Edison Company, who described the method in lighting the streets of New York.

Mr. Klingman, of the National Electric Lamp Association, thought that the ornamental magnetite arc lamps, which had been described by Mr. Rose, should be placed on a higher mounting to remove these high-power lamps from the line of vision. He agreed with the placing of the lamps on one side of the street because of the more uniform results. A statement that had been made by one of the speakers that the series tungsten system is suitable for small towns only, he considered entirely untrue because this system is very well adapted to all residence streets and suburban communities.

Mr. Rose thought that the European practice of hanging flaming-arc lamps very high cannot be followed in this country except in relatively few installations. Furthermore, in Europe the converging-carbon flame lamp is used much more extensively than the vertical-carbon lamp. For the former a great height is imperative; for the latter it is not so necessary because the distribution at angles near the horizontal is very much better.

Frank Price spoke strongly in favor of placing high-candlepower lamps at such a height that they will not interfere with vision along the street. He also strongly urged the use of good diffusing globes.

T. H. Aldrich referred briefly to the work that had been done by the committee, of which he was chairman, to get an increased height of suspension for the municipal flaming-arc lamps installed. He felt that, inasmuch as this committee had secured the co-operation of the city authorities in this matter, it was not unreasonable to expect their further co-operation in compelling the raising of all high-candlepower commercial lamps as well.

The wisdom of placing flaming-arc lamps on the residence streets as well as on the important business streets was questioned by F. H. Bernhard, who called attention to the opinion held by many street-lighting experts that there were three different classes of streets as regards importance and amount of traffic and that, therefore, there should be a corresponding amount of illumination provided for each class of streets.

A. L. Ettice emphasized this point and said that he knew from experience how annoying it was to have the brilliant rays from an arc lamp shining into a person's sleeping apartment. He felt, therefore, that the decision of the city to place the flaming-arc lamps on residence streets also would meet with considerable disfavor. This view was endorsed by Chairman Schuchardt and Messrs. Price, Klingman, Scheible and Aldrich.

H. Schaedlich, of the city electrician's office, explained why it had been decided to use the flaming-arc lamps on the lesser streets also. This was largely to secure uniformity of equipment and to meet the imperative demands of both citizens and aldermen for more powerful lamps. The authorities were not in favor of direct-current systems. The use of tungsten lamps had been tried out on a small scale in series with arc lamps and not been found entirely satisfactory. Mr. Haines also spoke along these lines.

J. R. Cravath spoke briefly on the matter of placing lamps on one side of the street only, which he was glad to see has received the endorsement of quite a number of illuminating engineers that have given the matter study. Others who discussed the subject were A. Scheible, S. E. Church and J. C. Herron.

AN ANALYSIS OF GLARE FROM PAPER.

By M. Luckiesh.

It is well known that glare in any of its various forms diminishes the effectiveness of an illumination. While the data presented in this paper will be largely applicable to other activities in which vision is concerned, the matter of reading will be chiefly considered. We are able to see printed letters because of the contrast between the dark letters and the bright background. If this contrast is diminished of course the ability to read with ease is decreased and any condition which diminishes this contrast should be eliminated if possible. While the position of the light sources with respect to the eye and the brightness of walls have considerable influence on visual efficiency, specular reflection from the paper is of very great importance in reading print.

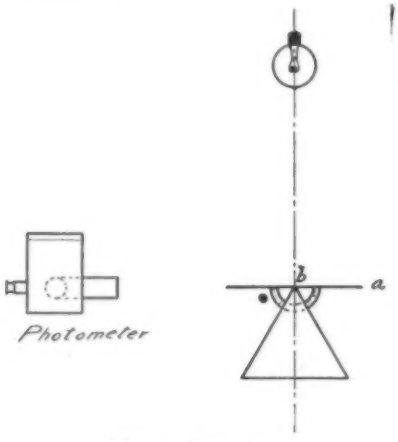


Fig. 1.—Apparatus.

The reflection from commercial papers is a combination of diffuse and specular reflection. The greater the amount of diffusely reflected light compared to the specularly reflected light, the less is the annoyance from glare. Those who have difficulty in forming an idea of these two kinds of reflection can construct a model of a semi-diffusing paper by placing a clear plane sheet of glass over a white mat surface such as blotting paper. The glass will reflect regularly while the blotting paper will diffusely reflect. The same kind of reflection occurs with commercial papers, but less perfectly. A numerical example will illustrate the decrease in the ability to read when the brightness due to regularly reflected light is of the same order of magnitude as the brightness due to diffusely reflected light. Assume a perfectly mat white surface with black letters upon it, illuminated to a degree which produces relative brightnesses of 100 units and 1 unit for the paper and letters respectively. The contrast ratio in this case will be 1/100. Now assume a white surface with black characters on it which is not matt but the contrast ratio due to diffusely reflected light is also 1/100. With the paper in a certain position light will be regularly reflected from it to the eye. Assume that the brightness of the letters and paper due to specular reflection alone is 100 units. This brightness is superposed on the brightness due to diffuse reflection and we now have a contrast ratio of

$$1+100:100+100 \text{ or } 101:200.$$

Obviously the ability to read has been greatly decreased even without considering the reduction in visual efficiency due to contraction of the pupil, scattered light in the eye, and various other influences. In many cases the specular reflection from the letters is considerably greater than that from the paper, owing to the fact that the pressure of the type has made the surface glossy. In such cases the contrast ratio will approach and even exceed unity. When it equals unity obviously it is impossible to read and when it is greater than unity the letters are brighter than the background. The latter result is noticeable on some papers.

The type and height of the lighting unit also largely influence the ability to read because of the character and relative brightness of the reflected image. The brightness of the paper and letters due to diffuse reflection varies approximately inversely as the square of the height of the lighting unit while the brightness due to specular reflection is approximately constant and depends on the intrinsic brilliancy of the source, although the image decreases in size as the height of the lighting unit increases. Partly for this reason, annoyance due to regular reflection very often disappears when the paper is held quite close to the lighting unit. Glare from paper then depends on the diffusion coefficient of the paper and the character and height of the lighting units employed.

Some experiments were performed for the purpose of studying the character of the reflected image from papers when various lighting units were employed at various distances. The apparatus was arranged to represent the conditions obtaining in reading as nearly as possible and yet be readily reproducible. A plane paper of glossy finish was placed on a board, *a* (Fig. 1), arranged to rotate on an axis, *b*, slightly below the plane of the paper. The light source was hung vertically over *b* and was adjustable so that any height desirable could be obtained. A Sharp-Millar photometer was placed with its tube as shown, its axis being perpendicular to the vertical line through *b* and the light source. The brightness of a point in the center of the paper was seen in the photometer field and as the paper was tilted the reflected image of the light source was seen to pass across the spot on which the photometer was sighted. This arrangement differs from a reading condition only in the position of the photometer. The line of sight would usu-

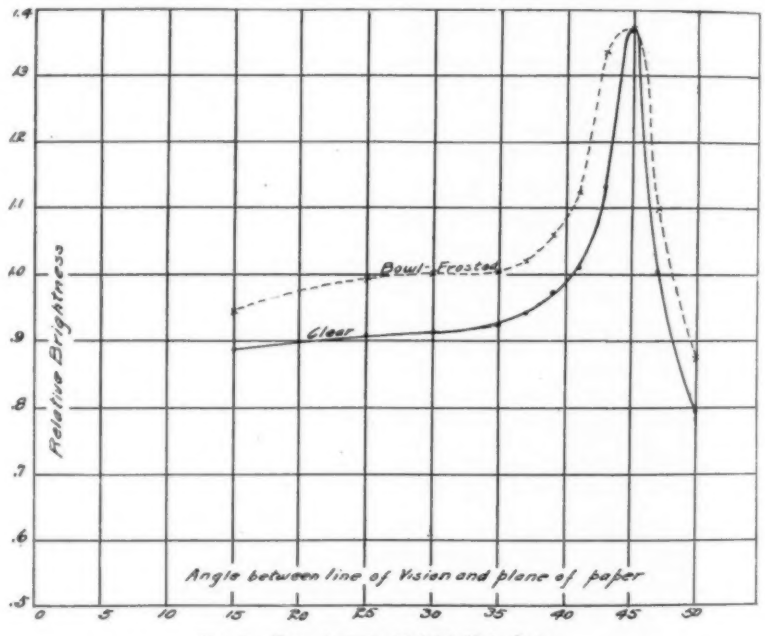


Fig. 2.—Bare Lamps, Height 16 Inches.

ally make an angle with the plane of the paper. When the photometer was placed where the eye might naturally be the results obtained were similar to those shown below; however, this arrangement did not permit of such a range in the tilting angles. It will be noted that the flux-density of incident light depends on the position of the paper and varies considerably throughout the range of angles used.

As desk lighting is one of the unsolved problems confronting the illuminating engineer, the light sources were first hung at 16 inches above the paper, which is a common height for desk lamps. Fig. 2 shows the results obtained with bare lamps. The ordinates represent the relative brightness of the central portion of the paper while the angles between the plane of the paper and axis of the photometer tube (or the line of sight) are plotted as abscissas. As all the tests were made with exactly the same apparatus, the relative shapes of the curves may be taken as the relative forms of the reflected images of the light sources. No significance should be attached to the fact that all the curves drop rapidly after an angle of 45 degrees has been reached, because at this point the flux-density of light on the paper begins to decrease rapidly. Fig. 3 shows the character of the reflected images of a prismatic reflector equipped with clear and bowl-frosted lamps. In the matter under consideration there seems to be little choice between the clear and bowl-frosted lamps. Fig. 4 shows the results obtained with an aluminized metal reflector especially designed for desk lighting.

As is evident from the above illustrations, the type of lighting unit when close to the work is of considerable importance when considering specular reflection from papers. From the shape of the curves in Fig. 4 it will be noted that little annoyance from specular reflection will be experienced with this type of reflector, because of the greater amount of diffused light from the paper and the low intrinsic brilliancy of a large part of the lighting unit. In this case the reflected image was distinguished with difficulty.

In Fig. 6 are shown the curves obtained with a prismatic reflector con-

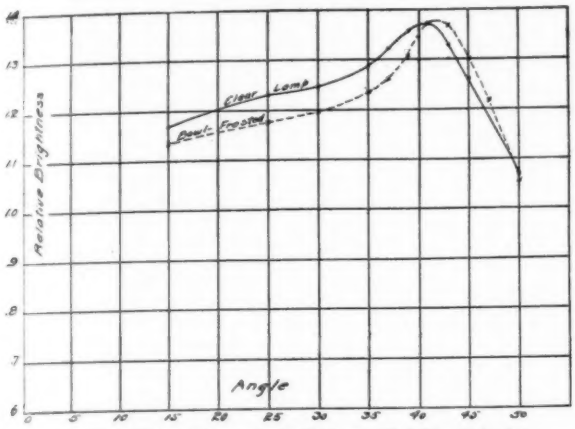


Fig. 3.—Intensive Prismatic Reflector. Height, 16 Inches.

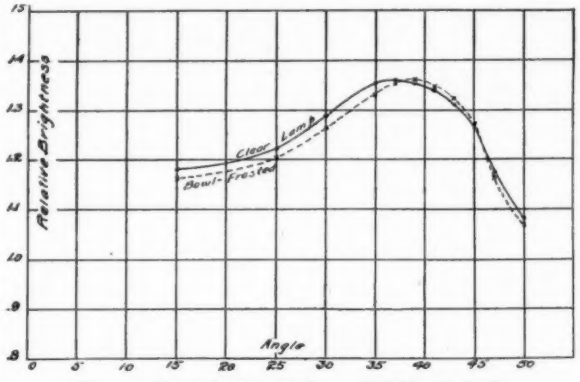


Fig. 4.—Aluminized Reflector. Height, 16 Inches.

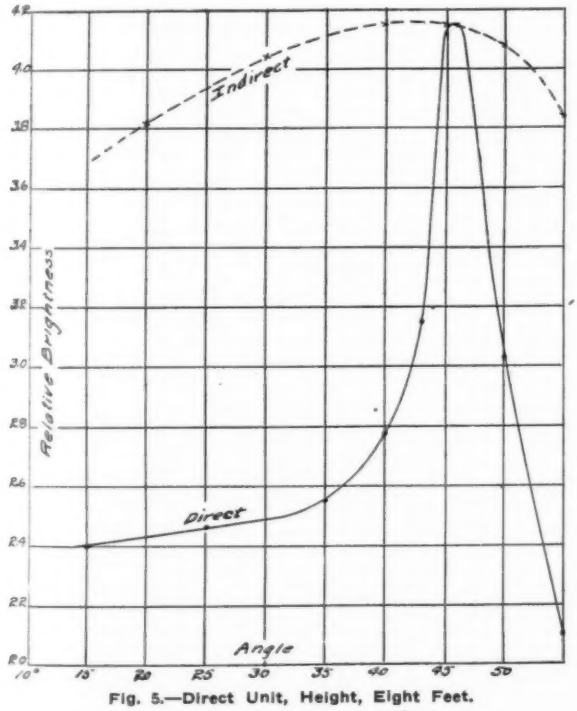


Fig. 5.—Direct Unit, Height, Eight Feet.

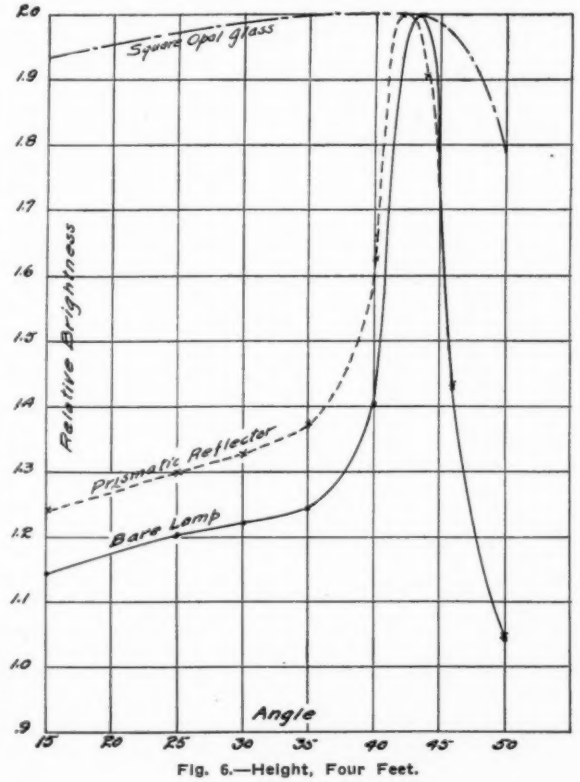


Fig. 6.—Height, Four Feet.

taining a bowl-frosted lamp compared with that of a bare lamp without a reflector, the height of the unit above the paper being four feet. Here the difference is very slight, which is characteristic of other direct-lighting units. There is also shown a curve obtained with a unit emitting light through a piece of opal glass 16 inches square. This glass was a first-class diffusing material and of low intrinsic brilliancy. Specular reflection was not noticeable in this case. The curve drops off at 45 degrees, owing to the fact that the paper is tilted so far at this angle that it receives much less light.

Based on the above information a desk-lighting unit was devised which was highly satisfactory. An opal-glass disk nine inches in diameter was placed in the opening of a metal reflector. This glass was illuminated by a 100-watt lamp and afforded sufficient light. This diffusing glass was of low intrinsic brilliancy and no annoying specular reflection could be detected even with highly callendered papers.

Fig. 5 shows the data obtained in a room indirectly lighted and in a room containing two direct units with prismatic reflectors containing bowl-frosted lamps. It is noted that with the indirect lighting glare due to specular reflection is practically absent, while in the room lighted with direct units the glare is quite annoying. In the latter case, however, the apparatus was placed directly under a unit which represents the worst possible condition. Distributed systems of direct lighting will be more desirable than this case shown in Fig. 5. However, in the matter under consideration the indirect system of illumination with its large secondary source of low intrinsic brilliancy is by far superior to any direct system, unless in the latter system the units are of low intrinsic brilliancy and are such as to throw considerable light on the walls and ceiling.

The above argument is based on the assumption that it is impossible to avoid the direct reflection from the paper. With a single unit it is often possible to hold the paper in a position which will avoid glare, although it often involves inconvenience. In many kinds of work, however, the position of the individual and his work is fixed and in such cases the system of lighting becomes highly important.

The influence of the height of the lighting units on the relative brightness of the regularly reflected image and the brightness due to diffuse reflection is seen by inspection of the curves for the prismatic unit shown in Figs. 3, 5 and 6. In these figures the height of the unit is, respectively, 1.33, 4 and 8 feet, and it is noted that the brightness of the reflected image of the source becomes relatively greater than the brightness due to diffuse reflection as the height increases. This is expected from the theoretical analysis.

The conclusions drawn from the work are as follows:

In all cases sources of low intrinsic brilliancy are desirable owing to the fact that the brightness of the regularly reflected image depends upon the intrinsic brilliancy of the source.

For desk lighting, where the unit is close to the work, properly designed reflectors with large diffusing surfaces, such as the aluminized reflector examined, produce less annoyance from glare.

When the unit is not close to the work there is little practical difference between the direct units examined, including the bare lamps.

The annoyance of regular reflection from the paper decreases when the direct system consists of distributed units, although there are positions where regular reflection is annoying.

With indirect lighting there is no noticeable specular reflection and therefore no annoyance from glare.

When the reader is free to move himself or his paper the system of lighting is of considerably less importance, but it becomes of great moment when glare from paper cannot be avoided owing to the fixed position of the work and individual.

Commercial paper having a matt surface and yet meeting the printer's requirements is now available and it is to be hoped that journals will adopt it. With the general adoption of this grade of paper the annoyance of glare from paper will disappear.

The Boston Electric Show.

The big electric show, which will occupy the entire Mechanics' Building in Boston, Mass., and run from September 28 to October 26, is reported to be the most magnificent and extensive undertaking of the kind that has ever been attempted, either in this country or anywhere in the world.

No electric show has ever had so much money expended in its promotion, development or in its management. This show is under the auspices of the Edison Electric Illuminating Company of Boston. The Boston Edison Company has assumed the responsibility of this show because of its desire to have everything absolutely first-class, have it more educational than merely commercial, and have it come up to the highest standard it is possible to set. The officers of the company were moved to undertake this enterprise, first, in order to carry through a great educational campaign for the increase and improved economy in the use of electric service, not only in the Greater Boston territory of the Edison Company, but throughout New England, which is served by over three hundred central stations. Another fundamental reason was the desire to show the people of Boston and New England that the company has sufficient civic pride to be willing to devote the energies of so large a staff of people, and to assume the responsibility for this enterprise, in order to show the world that Boston is the home of really big undertakings. The people of New England appreciate this kind of endeavor, and when it is taken by a public-service corporation the results bring remarkable returns in good will.

This show will be the product of over two years' hard work. Prospective plans were considered during the summer of 1910, and definite work was begun by a staff of experienced employees of the company in September of that year. The number of employees has been steadily increasing, and during the ten days preceding the opening of the Electric Show more than a thousand men will be employed day and night completing the details so that everything will be ready for the opening.

The Boston Edison Company will have spent, or contracted for the expenditure of over $150,000, before the doors of the show swing open on the first day. Every one connected with the show is confident that this money will be returned in actual cash admissions many fold; that there will be an attendance of three-quarters of a million people during the 29 days.

Special trains will run from all parts of New England, and there will be special electric cars bringing their loads of people ten to sixty miles direct to the doors of the Exposition Building.

The show has been advertised extensively in foreign countries. About a year ago advertisements were inserted in electrical papers in Japan, England, France, Germany, Austria and Italy asking for suggestions and information about novel, especially practical, and economical uses of electricity; and recently advertisements have appeared in the papers in the above-named countries and also in Brazil and Argentine Republic calling attention to special travel parties from abroad under the auspices of Thomas Cook & Son. It is expected that a large delegation of people will come from foreign countries.

Several exhibits have already been secured from foreign countries, the manufacturers interested being so impressed with the possibilities of this enterprise that they are willing to go to the expense of coming across the water with substantial displays.

SIMPLIFYING INDUCTION-METER CONSTRUCTION.

By H. W. Young.

The general advance during the past two years in the design and manufacture of induction-type watt-hour meters has been largely due to the demand of the central-station managers for a lower price form and to the expiration of patents which permitted several companies to develop and market new types. The central stations are therefore securing better meters and at a lower cost than seemed possible a few years ago; and this condition should now enable them to take on small-consumer business at a profit, as contrasted to the old haphazard flat-rate system.

Realizing that the selling price of a manufactured article is eventually fixed by competition, the meter designer and manufacturer was therefore forced to reduce the manufacturing costs, and this has resulted in a simplification of construction which hardly seemed possible until very recently. As is invariably the case, this redesign to secure simplicity also resulted in an improvement of the electrical characteristics, so that the general result has been beneficial.

One of the most marked tendencies of modern design has been to reduce the weights of the rotating elements, as it is recognized that any decrease in weight at this point has a most beneficial effect on the sustained accuracy. As an indication of the constant tendency toward lighter moving elements, the following tables will be of interest, as the data were secured from modern meters produced since the central-station agitation for lower-priced meters. It will be noted that the heaviest moving element weighs 32.9 grams or approximately 1.16 ounce; the lighting weighing 15.6 grams or 0.55 ounce, and the average of seven types is 22.7 grams or 0.92 ounce.

The ratio of torque to weight has also been materially increased, the lowest in the comparisons given being 1.13 and the highest 2.57. It is now generally appreciated that the values of "ratio of torque to weight" or the "ratio of torque to friction" are more correct measures of a meter's ability to give and maintain accuracy than is driving torque alone, even though it be abnormally high. With a high ratio of torque to weight, the effects of friction become of less value in impairing accuracy than when this ratio is low. The friction has been correspondingly decreased with the lighter moving elements and improvements in the bearing surfaces.

Another marked improvement secured in the later designs is in a reduction of the watt losses and current in the shunt or potential coils. In the tables given the term "watts pressure coil" means the loss in each meter due to the pressure coil being connected across the line, this loss continuing twenty-four hours per day. For example, meter No. 7 having a yearly loss of 14,016 kilowatt-hours per year; meter No. 7, having a yearly loss of 14,016 kilowatt-hours. The value of this saving to the central station would, of course, depend upon the value placed upon the energy consumed.

Fig. 1.—Single-Phase Induction Watt-hour Meter.

The term "current pressure coil" as used in the tables means the current flowing through the pressure coil as long as it is connected to the line, and this value varies to a great extent in different types. For instance, meter No. 5 requires 0.17 ampere, which, on the basis of 1,000 meters, gives a value of 170 amperes, which current, while shown on the station ammeters, is not recorded by the consumers' meters. As a comparison it will be seen that meter No. 7 requires but 0.03 ampere, giving a value of only 30 amperes for one thousand meters.

To convey some idea to the central-station manager of the problems involved in meter design, the table also incorporates the torque and weight values in English units. It will be seen that while meters are simply miniature motors they are of much lower power than is usually appreciated except by those intimately connected with their manufacture. As accuracy is one of the essentials of a successful meter and will be seriously impaired by small particles of dirt or other substances which find access to the meter unless it is exceptionally well constructed, it is highly important that the clearance between the rotating element and the damping or retarding magnets be sufficient to insure that the rotation will not be impeded. A comparison of the magnet gaps found in commercial meters is given in the table and shows a decided tendency on the manufacturers' part to safeguard the accuracy as much as possible by using a uniformly wide gap.

A few years ago meters were rather complicated mechanisms requiring expert care and considerable time to replace defective or burned-out elements. The central-station meter man of today, however, has a much simpler problem, as the general tendency on the part of manufacturers has been to make each part interchangeable, accessible and easily removed or replaced. As an example of the extent to which this accessibility of parts has been carried, one of the newer meters is shown in Fig. 1, for which claims are made that it can be completely taken apart and reassembled in twenty minutes by the ordinary central-station meter repair man. This is an interesting fact, especially to those who have followed meter development.

DATA ON STANDARD TYPES OF INDUCTION WATT-HOUR METERS.
(60 CYCLES, 110 VOLTS, SINGLE PHASE.)

Standard Induction Meters.	Watts, Pressure Coil.	Watts, Pressure Coil, for 1,000 Meters.	Current Pressure Coil.	Current Pressure Coil, for 1,000 Meters.	Torque, Millimetergrams.	Weight of Moving Element in Grams.	Ration of Torque to Weight.	Clearance Between Moving Element and Magnets.	Torque in Ounce with Radius of One Inch.	Weight of Moving Element in Ounce.
Type 1	1.5	1500	0.09 amp.	90 amp.	38.2	16	2.39	0.05 inch	0.053	0.564
Type 2	1.5	1500	0.08 amp.	80 amp.	38.2	16	2.39	0.05 inch	0.053	0.564
Type 3	1.25	1250	0.08 amp.	80 amp.	38.6	21.8	1.77	0.045 inch	0.0536	0.768
Type 4	1.5	1500	0.09 amp.	90 amp.	34.8	30.7	1.13	0.059 inch	0.0483	1.082
Type 5	2.	2000	0.17 amp.	170 amp.	42.1	26.1	1.61	0.023 inch	0.0584	0.921
Type 6	2.6	2600	0.12 amp.	120 amp.	72.2	32.9	2.2	0.035 inch	0.1001	1.16
Type 7	1.6	1600	0.03 amp.	30 amp.	40.0	15.6	2.57	0.051 inch	0.0556	0.55

Jovian Outing.

The Jovian Electrical League, of Philadelphia, Pa., has planned an outing to Kugler's Roost on June 8, 1912. A special train leaving at one p. m. will carry the members to their destination.

New Electrical and Mechanical Appliances

The Frink System of Bank Lighting.

Artificial light has to be relied upon to a greater or less degree by most large banks, inasmuch as they are located in the congested business districts of our large cities. To dispel darkness means to increase the efficiency of the working force of the bank. The cheapness of electric power is now so general that the electric lighting systems for bank illumination have largely superseded all other methods.

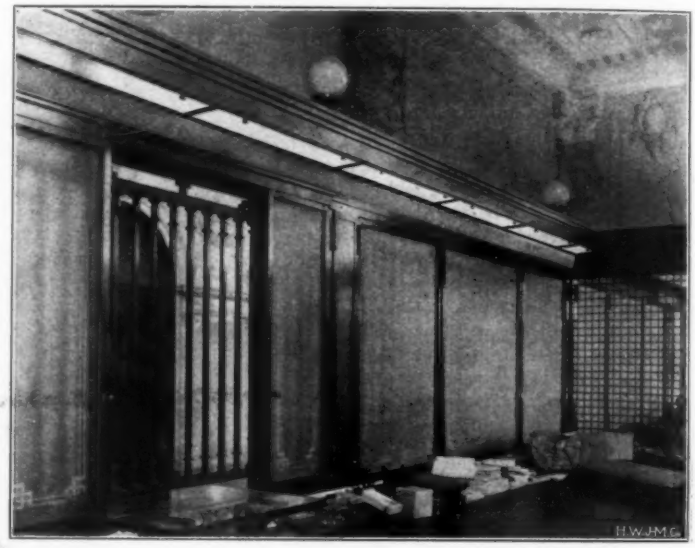
The architect, in most cases, has had to do with the specifying of the lighting systems, but in recent years he has called in an illuminating engineer and, by so doing, obtained a much better diffusion of light at a lower cost to the institution.

There are many prominent banks that are obtaining exceptionally good lighting results from the Frink system of bank illumination. The National City Bank and the Fourth National Bank of New York, and the First National Bank of Denver may be cited as examples of this system of concealed lighting.

The Fourth National Bank of New York is too well known to need any long description; suffice it to say that that it has one of the largest and most completely equipped banking rooms in this country, the area approximating 10,500 square feet.

The illumination system for a bank of such size required the most careful study in order to meet successfully the individual requirements of each desk, counter and table. In order to avoid spoiling the artistic lines of the cornices the lighting was made to harmonize with the prevailing finish, in this case old English oak. It was decided to have the entire Frink equipment, both fixtures and reflectors for the bank screens, desks, etc., made of cold-drawn bronze with statuary finish.

A lamp which is peculiarly adapted for bank lighting is known as the J-M Linolite carbon lamp. This lamp is tubular in shape, about one inch in diameter and 12 inches in length, and the light from it is distributed over the working surfaces by means of Frink reflectors, and without any dark spots or shadows. J-M Linolite lamps are manufactured by the H. W. Johns-Manville Company, New York. This lamp gives a soft, yellow light, which is very pleasing when used with bronze cornices and screens



Cornice Lighting of Tellers' Windows, Banking Room of Germania Life Insurance Company, New York City.

Lighting of Clerks' Desks, Fourth National Bank, New York City.

In Denver, the First National Bank has also installed the Frink combination cornice and light-diffusing reflector system. The continuous reflector on the main cornice sheds a sheet of light over the desk, besides forming a pleasing finish to the inner side of the cornice. The partition screen reflectors take the place of the ordinary cornice and light the desks on both sides.

The Frink system of bank illumination, being made up largely of the well known Frink reflectors, is now

recognized by many as the highest development of illuminating systems for banks. The designer and manufacturer of this system is the I. P. Frink Company, which is the oldest and largest maker of reflectors in this country, having been established in 1857. The H. W. Johns-Manville Company, New York, is the sole selling agent for the entire line of Frink products.

Recent Improvements in Keystone Direct-Current Instruments.

Direct-current voltmeters and ammeters have been for years constructed on the d'Arsonval principle, and this type of system is recognized today as the only one for use in accurate instruments. If, therefore, a better direct-current instrument is to be made, it is necessary to make improvements and refinements in construction and design of the standard d'Arsonval system.

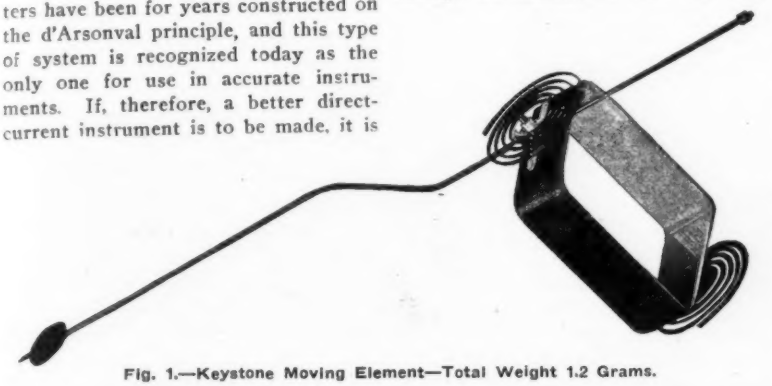


Fig. 1.—Keystone Moving Element—Total Weight 1.2 Grams.

As is generally known the d'Arsonval system or galvanometer is a modified form of the original tangent galvanometer, the fixed and moving elements having been reversed in position by Dr. d'Arsonval. In place of the moving magnet under the directive force of a solenoid, we have a small moving or rotating solenoid under the directive force of a permanent magnet. In the common form of switchboard and portable voltmeters and ammeters we have a coil, pointer, a counterpoise and controlling springs, which, together form the moving element that rotates in the magnetic flux between the pole pieces of the magnet and the core. Springs through which the current enters the moving coil oppose the motion of the coil and moving element and tend to bring the pointer to zero.

About nine months ago with the change in management of the Keystone Electrical Instrument Company, of Philadelphia, Richard P. Brown, who became president, was desirous of improving the construction of direct-current instruments, and with this in view spent considerable time in a study of the whole subject.

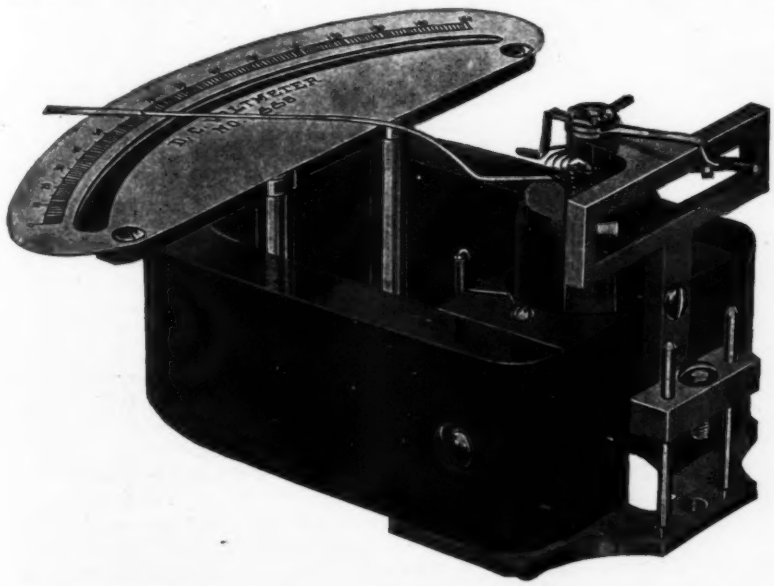


Fig. 2.—Keystone Direct-Current Instrument System, Showing Method of Removing Moving Element by Loosening One Screw.

To learn what has been accomplished in the construction of d'Arsonval instruments to date, one has simply to refer to the very able report known as Reprint No. 163, of the Bureau of Standards, at Washington, D. C., entitled "A Comparison of American Direct-Current Switchboard Voltmeters and Ammeters."

In a careful review of the above report one feature stands out most clearly, the importance of reducing the weight of the moving element in all instruments. Decreasing the weight of the moving element is the same as reducing the weight of any mass to be moved and the mass of half the weight can naturally be moved twice as easily. If we can cut down the weight of the moving element in the d'Arsonval system one-half, we not only reduce the wear on bearings and pivots, but increase the ratio of torque to weight and greatly improve the dead-beat qualities of the instrument.

The weight of the moving element in all instruments has been reasonably light, varying from 4.0 grams to 1.75 grams, the lightest moving element until recently. In an endeavor to reduce this weight to a minimum, the Keystone Electrical Instrument Company induced the manufacturers of aluminum to make up for it aluminum tubing for coil forms lighter than they had ever made, and also secured the lightest and smallest tubing possible to produce for the pointer. By means of a simple and redesigned construction for mounting the pointer on the coil form, a large saving in weight was effected at this point, and by constant efforts in this direction the weight of the Keystone moving element was reduced to 1.2 grams.

The resultant action of the improved instrument was as follows: When the full-load current was thrown on, the instrument came to rest in a half second whereas the period of the most dead-beat instrument heretofore was 0.8 of a second. The action of the instrument was so positive that it was almost impossible to follow the needle in its motion from zero to the maximum of the scale; thus an instrument is produced which is absolutely dead beat. As has been pointed out heretofore, this exceedingly light moving element relieves the pivots and bearings of considerable of their weight which it has been necessary to carry in the past. Particularly in engine rooms or on shipboard, where there is considerable vibration, the wear on the pivots and bearings is considerable, and if the weight is cut down to a minimum, the life of these pivots and bearings greatly increases, friction becomes negligible, and the instrument requires less frequent repairs, points which are self-evident.

The Bureau of Standards has also pointed out other advantages obtained

from the exceedingly light moving element which the Keystone Company has succeeded in constructing, as follows:

"In general we regard ratio of torque to weight as one of the very important, perhaps the most important, constant of an instrument, and we find that you have increased this ratio from 2.5 to 7.3 in the voltmeter, and from 1.9 to 4.5 in the ammeter. The short period and quick damping reduces the danger of injury from momentary overloads, and when used on fluctuating loads also reduces the pivot wear by limiting the swinging of the needle."

Another important feature in the performance and design of a direct-current instrument is in reducing the air gap between pole pieces and core to a minimum, at the same time having it large enough to prevent any danger of fine particles of dust interfering with the free swinging of the moving element. By much experimental work in this line it has been possible to reduce this air gap from 1.6 to 1.1 millimeters, and this feature is particularly advantageous, in that it increases the permanence of the magnet in addition to increasing the control or torque of the instrument.

As it may be necessary at any time for the user of an instrument to take the instrument apart, should any particles of dust or dirt interfere with the freedom of the motion of the moving element, a direct-current instrument must be designed to permit of easy removal of the whole moving element from the magnetic system. In Keystone direct-current instruments the whole moving element can be removed by the loosening of one screw as shown in Fig. 2. This is an improvement in construction which is greatly appreciated by anyone who has had occasion to take apart an electrical instrument heretofore.

To secure the greatest refinement it is essential that the scale plate and scale should be attached to the same base as the magnetic system. In instruments where the scale plate is mounted on the wooden or metal case instead of on the base of the system, should the case warp or change its relative position to the system, the pointer would no longer indicate zero and the instrument would read in error. It is essential, therefore, that the scale plate be carried on the same base as that on which the system is mounted, so that should the instrument system change its relative position with the case the whole scale and system will move together, the pointer remaining on zero and the indications be unaffected.

Another refinement which has been adopted in Keystone instruments, in accordance with a valuable suggestion of the Bureau of Standards, has been to enamel white all the interior of switchboard instrument cases. This not only gives the instruments a trim appearance, but shows up any slight particles of dust and dirt which might enter the instrument when the cover is removed. Where the interior of the case is of ordinary black japan it is impossible to see these particles of dirt.

Many of these small improvements may not seem of much moment in themselves, but they all tend to make an instrument of greater refinement. All of them are points which are clearly recognized as advantageous, the only difficulty having been in the past to produce these refinements.

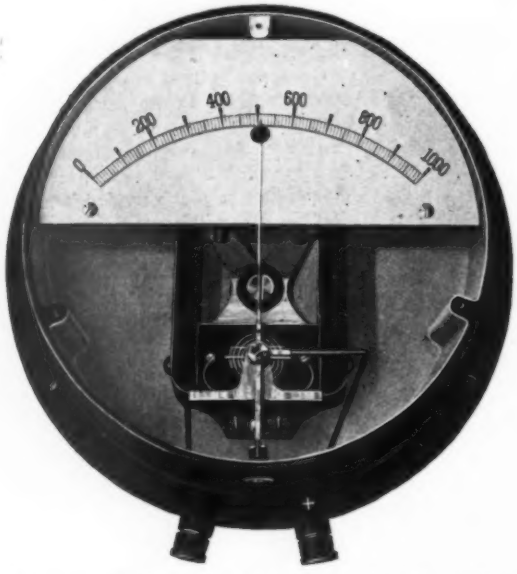
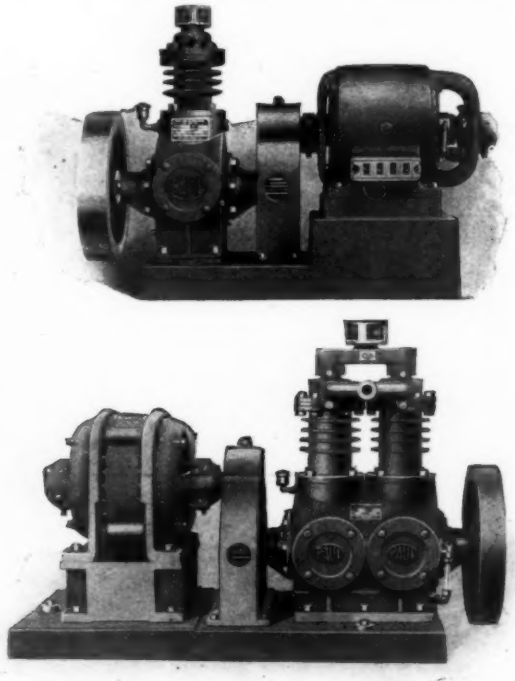


Fig. 3.—Keystone Instrument Assembled Without Front Cover.

Paul Motor-Driven Compressors for Pneumatic - Displacement Water Pumping.

The simplicity of the pneumatic displacement system of water pumping at moderate pressures has caused this system to be favored for private water-supply plants. By the development of a new and efficient pump and the perfection of other details, the Fort Wayne Engineering & Manufacturing Company, Fort Wayne, Ind., has been enabled to bring out a very reliable system of this type known as the Paul Non-Storage System of Water Supply, because it pumps the water direct from the well as needed.



Paul Single and Twin Air-Cooled Motor-Driven Air Compressors.

This system comprises an air compressor (preferably motor-driven), an air receiver to store the compressed air, a pressure-reducing valve to supply the air at constant pressure (equal to the required water pressure), an automatic valve which alternately puts this air pressure on the two chambers of a displacement pump, this pump itself which is placed near the bottom of the well, and the distributing piping which leads direct to the various hydrants and other points of discharge.

The Paul system can be made entirely

automatic or non-automatic as desired. Automatic motor drive of the air compressor is the preferred plan. For this purpose special motor-compressor sets have been designed. As shown in the accompanying illustrations, these are made in two types with single or double compressor. In each case the motor and compressor are directly geared together. The compressor is air-cooled and has a massive flywheel. The entire set is mounted on a substantial base with a casing inclosing the gears. Direct-current or alternating-current motors are supplied as desired. These sets are made in eight sizes, ranging from 1 to 7.5 horsepower and provide maximum air pressures of 80, 90 and 100 pounds. These compressor sets have also been found serviceable for other duty, aside from water pumping, where these sizes and pressures are suitable.

The company also manufactures other motor-driven pneumatic pumping equipment for both shallow and deep wells.

Roxite—A Heat-Resisting Molded Insulation.

Under the trade name "Roxite" the Northern Industrial Chemical Company of Boston is manufacturing a molded insulation capable of resisting high temperatures. The development and investigation of Roxite was carried on in the laboratory of the manufacturers and is the final result of a systematic chemical investigation covering a period of three years. During this time Roxite has been subjected to every conceivable test and kept under constant observation, so that every point has been perfected before putting it before the trade. It is a scientific product, developed by trained chemists and is made under chemical supervision so that it is always to be depended upon.

Roxite is a composition which the manufacturers can mold into any form, no matter how intricate, and after it is molded it becomes hard and cannot be softened by heat even if heated red hot. Pieces can be molded with metallic inserts in the same way as shellac goods. Another valuable property of this insulation is the fact that it is unaffected by oils or water and will not support combustion. Where high dielectric strength is required Roxite fulfills the requirements and in places where a high finish is necessary it also finds application, as it is very hard and capable of taking a high polish.

The manufacturers claim that this insulation combines heat resistance, incombustibility, hardness, tensile strength, inertness toward oils, water, etc., and high dielectric strength in one, making Roxite an ideal insulation. It is made in several forms according to the special properties required.

New Benjamin Lighting Devices.

The Benjamin Electric Manufacturing Company, of Chicago, Ill., is marketing several new devices which should prove of considerable value to textile mills and other manufacturing plants and factories. The first is a porcelain drop-cord socket which is adapted for all classes of indoor pendent-cord lighting where key sockets are not required. It is a one-piece socket with threaded

Drop-Cord Socket.

bushing constituting the cap. The latter, in combination with a projection on the porcelain, forms an effective cord grip making it unnecessary to use other strain-relief means. A particular feature is furnished in the way of positioning offsets for attaching reflectors. These make it possible to use smaller lamps or change the light distribution

Shade-Holder.

by simply shifting the reflector from the lower to the upper position. Three types of holders are furnished for adapting the socket for ordinary shades and glassware.

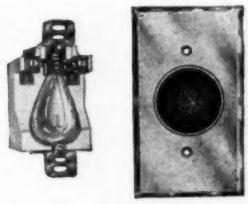
The second device is an enameled-steel reflector with shade-holder attached for either the drop sockets described or standard brass-shell sockets. These reflectors are made in four sizes and cover a range of lamps from 25 to 250 watts. They may be supplied with wire guards. In addition to the usual protection offered the lamp, these guards furnish a means for attaching a ground wire where the static charge from moving belts would otherwise injure the lamp filament.

Holder-Type Deep Bowl Reflector.

Bryant Pilot-Lamp Sets as Tell-Tales for Current-Consuming Devices.

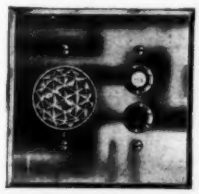
Recognizing the demand for pilot lamps in connection with current-consuming devices, the Bryant Electric Company, of Bridgeport, Conn., has designed three outfits by means of which any desired flush combination can be secured. These are shown by the illustrations herewith.

The single receptacle containing the



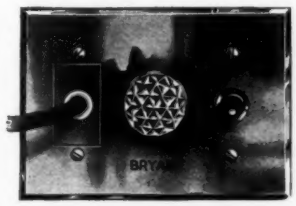
Pilot Lamp Fitting Standard Box.

lamp, which can be used with the bull's eye plate, will doubtless prove very popular as it can be used in any combination with flush switches or receptacles fitting standard boxes.



Pilot Lamp and Push Switch.

The second device is a combination pilot lamp and flush switch and is ready wired. It can be installed by making connections with but two binding posts in each instance. The porcelain cups are designed for use in regular two-gang standard boxes. It serves as a constant reminder that the circuit controlled by the switch is closed.



Push Switch, Pilot Lamp and Attachment Plug.

The third outfit is a combination pilot lamp, push switch and attachment plug with all attachments made and ready to install in a standard three-gang box. It is especially useful in safeguarding flatirons and other heating or cooking devices where the operator is liable to become forgetful and leave the current on indefinitely.

New Adaptibox Combinations.

Without adding a single new item to their list of parts, the manufacturers of the Adaptibox have developed five very useful new combinations, which are shown herewith. They are all made up by using the so-called "angle lug" in different combinations with the standard base and blank side plate. They illustrate forcibly the wide range of adaptability of these fittings.

The Adaptibox is a conduit fitting made on the sectional principle. A base, four side plates or lugs, and a cover comprises the complete unit. These can be used in any desired combination so that the contractor is enabled to meet any possible contingency in a conduit job by very easily re-assembling

Fig. 1.—Adaptibox No. 3600 for Corner Switch or Receptacle.

standard Adaptiboxes into any desired form.

Figs. 1, 3 and 4 show the adaptability of the Adaptibox in a convincing manner. Here are three wholly different boxes made up from identically the same parts—a base, two blank side plates and two angle lugs. The contractor who has any one of these units in stock, has all three; because he can re-assemble these parts to make any of the combinations shown. It only requires a screw driver and about two minutes of time. None of the combinations is a make-shift; each complete Adaptibox fulfills its purpose completely. When the parts are assembled,

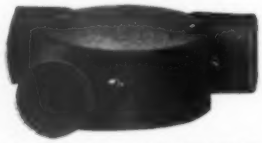


Fig. 2.—Adaptibox No. 3700 for Right-Angle Branch.

the finished box is as sturdy as a solid casting.

No. 3700 (Fig. 2) is a type of fitting largely used where feeders are run up elevator shafts or through the floors of buildings with branches taken off at right angles. This unit is made up of the base, three angle lugs and a blank side plate. No. 4000 (Fig. 5), which is made up of the base and four angle lugs, is the only fitting that accommodates two conduits running into it parallel. This avoids offsets and bends in the line of conduit which are unavoidable when other fittings are used.

It will be seen that the contractor, who has a stock of, say, No. 3700 Adaptiboxes on hand, may make up any of these combinations in two minutes. If he wants a No. 4000 combination, he simply takes two No. 3700's, removes the blank side plate from one and sub-

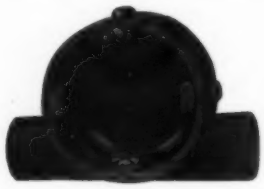


Fig. 3.—Adaptibox No. 3800 for Switch or Outlet at Edge of Wall or Ceiling.

stitutes an angle lug from the other. He also reverses one of the angle lugs, as it will be seen that one lug in the No. 3700 combination points out instead of being parallel to its mates. He then has a No. 4000 and he also has left two angle lugs and two side plates, with which he can make up either No. 3900,

Fig. 4.—Adaptibox No. 3900 for Switch on Reverse Conduit Bend.

3800 or 3600. The contractor thus makes any or all of these combinations, which meet a wide range of requirements, without going outside his shop for special material and he only invests in one of the units shown.

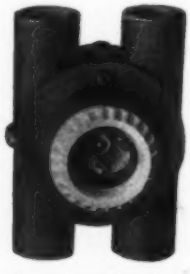
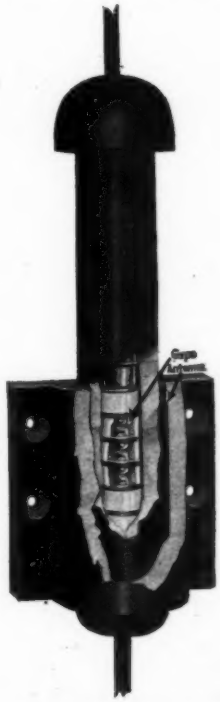


Fig. 5.—Adaptibox No. 4000 for Two Parallel Conduits.

This economy of investment, saving of time, postage, expressage, etc., incident to getting special material to take care of unexpected conditions, is the vital advantage of the Adaptibox. The contractor with a very small stock of these units and an assortment of extra lugs and covers, is in position to handle any problem that may arise without the least trouble, delay or expense. The little jobs that take a couple of hours time and require some special fitting, can be handled at a big profit by the man who has learned to adapt these units to meet conditions. And the big jobs, where the margin is close and the danger of underbidding is serious, can also be handled more profitably because Adaptiboxes are easier to work with, they are roomier, and they make unnecessary a great deal of pipe bending and fitting. Adaptiboxes are made by the Bonnell Manufacturing Company, Cleveland, Ohio.

Compression-Chamber Lightning Arrester for Pole Transformers.

To meet the demand for a lightning arrester that will give adequate protection to distributing transformers, at a price that will permit its use



Compression-Chamber Lightning Arrester for Pole Mounting.

for even the smallest transformers, the General Electric Company has recently placed on the market a new multigap arrester known as the compression-chamber type.

In this new arrester the two conflicting requirements of a successful arrester, namely, ability to discharge at a low potential and prompt cutting off of the generator current have been met with remarkable success. In this arrester, as in the older type of multigap arrester, the basis of operation is the rectifying action of the gases which extinguishes the dynamic arc.

Two special features, the use of an antenna and the compression of the gases in the gaps, increase the efficiency of the arrester.

The U-shaped antenna is connected at the bottom to the ground lead, and its arms extend near and parallel to the series of gaps. By its condenser effect the antenna reduces the potential at which the arrester will discharge, and thus permits the use of a large number of gaps which are superposed on each other. This large number of gaps and the compression of the gases in an airtight chamber give prompt extinguishment of the dynamic arc. A series resistance of low value mounted directly above the gaps reduces the generator current to a point where it can be easily handled by the arrester.

The insulating case is a porcelain tube with all joints filled with waterproof insulating compound. This feature does away with the necessity for inclosing the arrester in a box and aids considerably in reducing the cost of an installation.

The compression-chamber multigap arrester is not intended to supersede the multigap arrester with graded shunt resistance, but simply to meet the demand for a reliable arrester where the more complete protection given by the latter is not necessary and the expense of installing it is not justified. The new arrester has been tried out by severe laboratory tests and by several months' service on the lines of a large operating company. In all these tests it has thoroughly demonstrated its reliability.

Electric Solder Pots.

The many advantages offered by electricity in the rapid and economical generation of heat for commercial purposes are becoming more appreciated each day. The numerous and varied industries that are adopting this form of heat, to the exclusion of the primitive and dangerous open flame, offer mute testimony as to its adaptability. This new sphere of usefulness has been further emphasized by the recent development of the electric solder pot made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

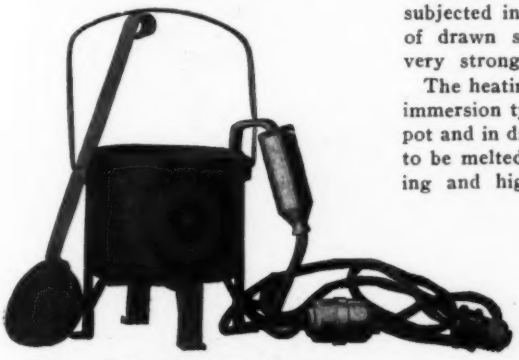


Fig. 1.—Solder-Pot Outfit Complete.

Electric solder pots for individual use form the most satisfactory, economical, and safe means of melting and keeping in a liquid state such metals as solder, tin, lead, and babbitt. They reduce the fire hazard, keep the loss of metal through oxidization to a minimum, and introduce no unhygienic conditions, such as fumes and smoke, into the work room. The uniformity of the temperature of the molten metal is also a valuable feature; if the pot is kept filled, the temperature of the metal will always be at the proper point.

The use of individual pots insures good, rapid work. Where the metal must be carried to the work in ladles, a great deal of the workman's time is lost, and the metal cools rapidly, thus making bad joints. There is also a considerable loss of metal as the residues are not always returned to the melting pot. Furthermore, with the individual pots the danger of serious burns to workmen is practically eliminated.

Fig. 2.—Heating Element for Solder Pot.

As shown in Fig. 1, these pots are substantially constructed in order to withstand the abuse to which they are subjected in service. The pot is made of drawn steel, and though light, is very strong.

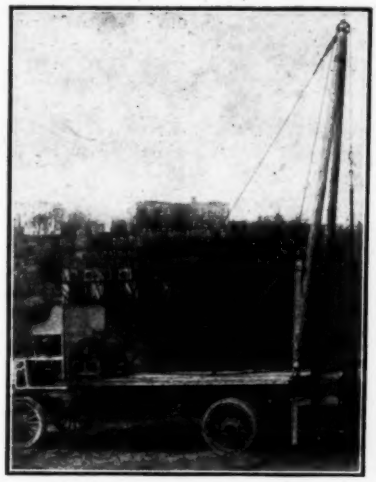
The heating element, Fig. 2, is of the immersion type; it is separate from the pot and in direct contact with the metal to be melted. This insures quick melting and highest efficiency. None of the heat is wasted as it must pass through the molten metal before any can escape. The heating element is hermetically sealed under pressure in an iron jacket and is practically indestructible in service.

The heater can be run at two temperatures, the high heat for melting the metal quickly and the low heat for keeping it in a liquid state. A push-button switch controls the temperature and indicates which heat is being used.

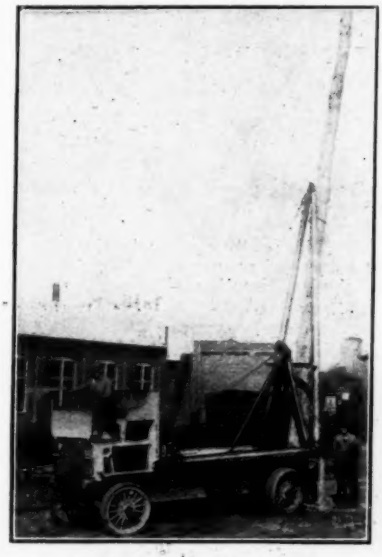
Mack Post-Hole Digger and Derrick.

The International Motor Company, New York City, has just put on the market an interesting post-hole digger and derrick, which is one of the most unique applications of the motor truck so far made.

The truck is designed like the standard three-ton type such as the company has supplied in large numbers to the Associated Bell Telephone Companies throughout the country. The platform of the rear of the truck is reinforced with heavy I beams and over the rear end of the truck is erected a boom that can be raised or lowered. This boom supports the drilling apparatus which is a modified carpenter's expansion drill. The drill is about one foot long and has a disk-shaped plate with tooth cutting edge which throws



Lifting the Dirt from Hole.



Lowering Pole Into Hole.

up the earth as the drill bores into it. This disk also supports the core of loose earth and at a signal to the driver of the truck, the drill can be raised and drawn from the hole by a cable attached to a standard which is operated by the truck motor. After the hole has been drilled and dirt removed, the chain is fastened about the pole to be set and in a few minutes the pole is hoisted and dropped in.

The value of this outfit can be fairly imagined from the fact that two men working together can dig about four post holes in a day and that it takes a very considerable gang of men, after the holes are dug, to set the poles and tamp the earth around them. The Mack post-hole digger and derrick can haul the poles to the spot selected, dig the holes and then set the poles. Not only is it a money saver, but it is possible to set many more poles in a given time than by the old method.

The machine is the result of many months of thorough tests and experiments before the apparatus was offered in commercial form. In a recent test of the Mack post-hole digger and derrick witnessed by James Cunningham and E. C. Spey, of the engineering department of Bell Telephone Company of Philadelphia, a demonstration was made of the digging capabilities of the truck in all kinds of soil including the toughest kinds of clay. The outfit met every test required of it and has been sanctioned by the engineering department of the company. It is expected that it will find a large field of application in the future in telephone and electrical line construction service.

Latest Approved Fittings

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.

FLEXIBLE CORD.—Standard: National Electrical Code, 1911 Edition.

The following additional companies are now supplying these cords properly tested and labeled by the Underwriters' Laboratories:

American Electrical Works, Providence, R. I.
Marking: Yellow thread cabled with the copper strands.
Approved April 9, 1912.

Bishop Gutta-Percha Company, 420 East 25th Street, New York, N. Y.
Marking: One green cotton thread running parallel with wire between the rubber insulation and braid.
Approved April 8, 1912.

Boston Insulated Wire & Cable Company, Hamilton, Ontario, Canada.
Marking: Blue threads in cotton wind around copper strands in clockwise direction.
Approved April 20, 1912.

Boston Insulated Wire & Cable Company, Dorchester District, Boston, Mass.
Marking: Blue threads in cotton wind around copper strands in counterclockwise direction.
Approved April 19, 1912.

Detroit Insulating Wire Company, Wesson Avenue and Albert Street, Detroit, Mich.
Marking: One red thread in the cotton wind.
Approved April 8, 1912.

Electric Cable Company, Bridgeport, Conn.
Marking: One white thread cabled with copper strands.
Approved April 8, 1912.

General Electric Company, Schenectady, N. Y.
Marking: Green threads in cotton wind around copper strands.
Approved April 8, 1912.

Goodyear Rubber Insulating Company, 105 East One Hundred Thirty-First Street, New York City, N. Y.
Marking: One red and two green threads cabled with copper strands.
Approved April 9, 1912.

Indiana Rubber & Insulated Wire Company, Jonesboro, Ind.
Marking: One black thread in cotton wind.
Approved April 9, 1912.

Marion Insulated Wire Company, Marion, Ind.
Marking: One blue thread cabled with copper strand.
Approved April 9, 1912.

SWITCHES, OIL BREAK.—Condit Electrical Manufacturing Company, Boston, Mass.

Standards for the construction and test of oil switches of both the manually-operated or non-automatic type and the automatically-operated or circuit-breaker type are under consideration.

Pending the establishment of such standards, the results of examination of construction details and reports of satisfactory performance in the field indicate that the 600-volt, alternating-current oil switches and circuit-breakers made by this manufacturer are suitable for use.

This company is also prepared to furnish for circuits of higher voltages oil switches and circuit-breakers which it guarantees to be suitable for use at the assigned ratings of current and voltage. Inspection departments having jurisdiction should in all cases be consulted before such switches or breakers are installed.

Approved March 18, 1912.

WIRES, RUBBER-COVERED.—Standard: National Electrical Code, 1911 Edition.

The following additional companies are now supplying these wires properly tested and labeled by the Underwriters' Laboratories:

Acme Rubber Manufacturing Company, Trenton, N. J.
Marking: Two red threads woven into braid, crossing each other.
Approved April 25, 1912.

Boston Insulated Wire & Cable Company, Hamilton, Ontario, Canada.
Marking: One coarse uncolored thread woven in braid in a clockwise direction.
Approved April 19, 1912.

Collyer Insulated Wire Company, Pawtucket, R. I.
Marking: Two blue threads crossing in braid.
Approved April 26, 1912.

Goodyear Rubber Insulated Company, 105 East One Hundred Thirty-First Street, New York City.
Marking: Two green and one red threads woven parallel in braid.
Approved April 22, 1912.

Home Rubber Company, Trenton, N. J.
Marking: Three red threads crossing in braid.
Approved April 27, 1912.

Imperial Wire & Cable Company, Ltd., Montreal, Canada.
Marking: Yellow thread woven in braid (or one blue, green or black thread in a red braid.)
Approved April 30, 1912.

Lowell Insulated Wire Company, Lowell, Mass.
Marking: Two yellow threads running parallel with wire between rubber insulation and braid.
Approved April 25, 1912.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

GRISWOLD, IOWA.—This city will install three blocks of cluster lights. C.

UNDERWOOD, N. D.—Bonds for $8,000 were voted for the erection of an electric light plant. C.

NORTH ST. PAUL, MINN.—The Council is considering the installation of an electric light and power plant. C.

STOCKDALE, TEX.—Colley & Billingsley contemplate installing an electric light and power plant at Stockdale. D.

CHICO, CAL.—The Union Mining & Power Company has been organized and H. A. Routh elected secretary.

CHISHOLM, MINN.—The Mesaba Electric Company has bought a site for the proposed station and work will be started soon. C.

JESUP, GA.—Bonds to the extent of $35,000 have been voted for the purpose of equipping the town with a high-power electric plant.

LIBBY, MONT.—The Milwaukee Electric Power Company will begin construction within a month on the power plant at Yahk Falls. C.

VALDOSTA, GA.—The Consolidated Ice & Power Company of this city will spend in the neighborhood of $150,000 in improvements to its plant.

LONGMEADOW, R. I.—A franchise has been granted to the United Electric Light Company, Springfield, Mass., to extend its service to this town.

JOLIET, ILL.—The Public Service Company if awarded the municipal contract for street lighting will install a new system at a cost of $20,000.

McINTOSH, MINN.—Business men of McIntosh, headed by Julius Halvorson, have secured enough money to install a "White Way" in their town.

PROVIDENCE, R. I.—The Westerly & Connecticut Railway Company is planning to build a new substation power plant near Pleasant View Beach.

ADAMS, N. Y.—The Adams Electric Light Company is contemplating building a pole line to Watertown to connect with the power wires of the Watertown Light & Power Company.

HOOD RIVER, ORE.—The Hydro-Electric Light Company will soon begin the work of extending its line from this city to The Dalles, a distance of 24 miles.

WATERLOO, IOWA.—The Citizens Gas & Electric Company will erect a transformer station here and one in East Waterloo. The two buildings will cost $10,000. C.

PALO ALTO, CAL.—Bonds to the amount of $20,000 have been authorized for a municipal light plant, and $12,500 for the machinery to be installed in the plant.

KERRVILLE, TEX.—The electric light and power plant and the ice factory have been sold to T. Holdsworth. Additions and improvements will be made to the plants. D.

ONAWA, IOWA.—The Civic Improvement League has requested bids on material and installation for 20 electroliers with cluster lighting. E. D. Corr is secretary.

CHATTANOOGA, TENN.—The Chattanooga Railway & Light Company has announced that $250,000 will be spent in improvements. W. E. Boileau is general manager of the company. G.

NORFOLK, NEBR.—The Norfolk Light & Power Company will build a high-tension electric line from Norfolk to Tilden. The line will be built to carry 16,000 volts of electricity.

GLENCOE, MINN.—Central Minnesota Light & Power Company has been incorporated with a capital stock of $100,000 by B. F. Allen, H. B. Rutledge, C. M. Tifft, and Jay Greaves, all of Glencoe.

HUALAHUISES, NUEVO LEON MEX.—Preparations are being made for the installation of a municipal hydro-electric plant on the Hualahuises River to furnish lights and power for the town of Hualahuises. D.

POST, TEX.—The Post Power Company will install an electric light and power plant here. The company has a capital stock of $100,000. C. W. Post of Battle Creek, Mich., is at the head of the project. D.

PADUCAH, KY.—Mayor T. N. Hazelip has under consideration plans for an ornamental lighting system on Broadway from First to Tenth Streets. The Board of Trade of Paducah is assisting in carrying out the plan. G.

SELMA, ALA.—Walker Reynolds, of Anniston, has in charge the matter of establishing a "Great White Way" in Selma. It is estimated that it will cost $1,200 a block and that three blocks on Broad Street will be so lighted.

SAN FRANCISCO, CAL.—The Indian Valley Light & Power Company has applied for authorization to issue $145,000 of new stock. The revenue thus derived will be used to enlarge the company's facilities on the north fork of the Feather River.

CADIZ, KY.—Alexander Brothers are planning the installation of an electric light plant. The franchise for the operation of the system was secured several months ago. They will operate the plant in connection with an ice factory which they are now building. G.

SPENCER, MASS.—A franchise has been granted to the Central Massachusetts Electric Company for pole locations for supplying electricity for light and power purposes. The franchise stipulates that the work must be completed within one year.

FLORENCE, S. C.—A franchise has been granted to the Electric & Utility Company. L. C. Ritchie, president of the company, states that a much larger plant will be erected to furnish light and power to industrial concerns in the surrounding country

GOUVERNEUR, N. Y.—The Hannawa Power Lines expect soon to extend the lines to Pyrites, a distance of 13 miles. The survey for the line has been completed and rights of way obtained. The line will carry 80,000 volts and will cost $4,000 a mile to build.

NEWPORT, KY.—The Business Mens' Club has under consideration plans for the erection of an ornamental lighting system on York and Monmouth Streets. Current will be furnished by the Union Light, Heat & Power Company. Mayor Helmbold is also taking an interest in the matter. G.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has been granted a certificate of public convenience and necessity to exercise its franchise rights in the towns of Gilroy and Morgan Hill, and the county of San Benito for the transmission of electric power lines.

CADIZ, KY.—A. P. White & Company who are erecting a flour mill to be operated by electricity, generated by water-power, are planning the operation of an electric light and power plant in connection with the mill. L. S. Ragsdale, of Pembroke, Ky., will be in active charge of the plant. G.

HAUTO, PA.—Involving an ultimate expenditure of $10,000,000 the Lehigh Navigation Electric Company is installing its new main generating station at this place. It is understood that this is the inauguration of the largest electrification project since the establishment of the Niagara Falls power plants.

WENATCHEE, WASH.—The Wenatchee Valley Gas & Electric Company plans to soon string service wires on the east side of the Columbia River, thus being in a position to supply electric light service to a large district which for years has been making efforts to obtain electric lights.

MONTEREY, MEX.—The Monterey Railway, Light & Power Company, which has a franchise from the Municipal Government for installing a plant for the manufacture of gas, and the construction of a distributing system at Monterey, is preparing to start work on same. W. A. Aldridge, of Grand Rapids, Mich., is the engineer in charge of the project.

ANNISTON, ALA.—Alabama Power Development Company is planning to build a second hydroelectric plant, construct a dam and power house on Choccolocoo Creek and extend its present transmission lines from Jackson Shoals to the new development. F. L. Dame, 71 Broadway, New York, is reported to have the matter in charge.

ALAMEDA, CAL.—This city has voted a $150,000 bond issue for the construction of a new fire-proof power

station and additional generating apparatus for the municipal electric lighting plant. Alameda is installing a tungsten street lighting system with ornamental posts, which it intends to extend to every street within the city limits.

PINE BLUFF, ARK.—T. J. Hannan, of St. Louis, Mo., and associates, are making preparations to install a large hydroelectric plant on the Ouachita River in this state. They will construct power transmission lines to Little Rock, Hot Springs, Pine Bluff, Argenta and other industrial centers. It is stated that the proposed plant and power system will cost about $2,000,000. D.

GOSHEN, IND.—The Goshen Public Service Company has filed articles of incorporation with the Secretary of State. The initial capital is $10,000. The object of this company it to acquire all necessary rights, franchises and property necessary, proper and suitable for the generation, acquisition and distribution throughout the city of Goshen of water, light heat and power. Milton O. Payne, Charles R. Scott and Wilbur L. Stonex are the directors.

AUSTIN, TEX.—Material is being assembled for the construction of the big dam across the Colorado River at Austin which is to furnish initial power for a large hydroelectric plant. The franchise for the dam and hydroelectric plant is held by the City Power Company of Hartford, Conn., which has let the contract for the construction of the works to the William P. Carmichael Company, of St. Louis, Mo. Besides constructing the dam and electric power station the contract calls for the construction of a 10,000,000-gallon reservoir among the adjacent hills. Two 6,000,000-gallon pumps will be installed. It is stipulated that the hydroelectric plant shall produce a minimum of 600,000-horsepower hours of energy in every thirty-day period. During all but the dry season the output of power will be much greater than this minimum, it is stated. Preparations are being made for the construction of an interurban electric railway from this city to the site of the dam.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

PASADENA, CAL.—The Home Telephone Company proposes to establish an exchange in South Pasadena.

LEAD, S. D.—The Nebraska Telephone Company will spend $50,000 this year on improvements and extensions in the Black Hills District. C.

GLENDALE, KY.—Glendale Telephone Company has been incorporated with a capital stock of $500 by Eugene Stewart, H. M. Hatels and Garland Ash.

VANOSS, OKLA.—Vanoss Telephone Company has been incorporated with a capital stock of $1,000 by A. H. White, H. L. Brook and J. S. Jones, all of Vanoss.

COLUMBIA, S. C.—The Hurricane Telephone Company has been commissioned with a capital stock of $500. The petitioners are J. E. Pearsons and J. M. Garrett.

ROCK RAPIDS, IOWA.—The Farmers Mutual Telephone Company has been incorporated with a capital stock of $10,000. The incorporators include T. F. Collins, H. J. Meester and John Rohlff.

ARMSTRONG, IOWA.—The Northwestern Mutual Telephone Company has been incorporated by J. T. Cheever, J. F. Houseman and others. The capital stock is $3,000.

RUSHMORE, MINN.—The Farmers Mutual Telephone Company has been sold to the Fulda Telephone Company, which will put in about $10,000 worth of improvements. C.

OGEMA, WIS.—Ogema Telephone Company has been incorporated with a capital stock of $3,500 by August Hden, A. W. Nelson, A. Struve, George Dahl and O. V. Soderstrom.

FRANKFORT, KY.—Old Bainbridge Telephone Company, Old Bainbridge, has been incorporated with a capital stock of $500 by J. L. Saddlet, B. F. Wood and W. D. Olden.

HACKENSACK, N. J.—The New York Telephone Company has been given permission to place its wires underground under the country roads of the borough of East Rutherford.

CHOTEAU, MONT.—The Independent Telephone Company will make its line metallic between here and Conrad, and the line to Bynum will be rebuilt, and extended to Dupuyer. C.

DULUTH, MINN.—The Zenith Teleplone Company will build a new central exchange and extend the line to the Lakeside District, and make other improvements to cost $178,000. C.

LIVINGSTON MANOR, N. Y.—Livingston Manor Telephone Company has been incorporated with a capital stock of $3,600 by James G. Stevens, W. R. Woolsey and Robert J. Hoag.

THOMASVILLE, GA.—The Thomasville Telephone Company will replace the switchboard that was recently destroyed by fire. It is expected that this will cause an expenditure of $9,000.

MESILLA PARK, N. M.—Steps are being taken by a number of citizens, headed by W. S. Gilliam, to install an independent telephone exchange here. A company will be organized.

VERNDALE, MINN.—Verndale-Bartlett Telephone Company has been incorporated with a capital stock of $650. Among the incorporators are Peter Lage, A. K. Anderson and A. G. Rentz, of Bartlett.

ST. PAUL, MINN.—Eastern Farmers' Telephone Company has been incorporated with a capital stock of $9,000. Leander Peterson, Frank Hellgren and August Peterson are named among the incorporators.

McKINNEY, TEX.—The Union Telephone Company is assembling the material for the construction of a long-distance line between McKinney and Greenville. It will also build a line to Pilot Point and Denton.

ROCKWALL, TEX.—Rockwall Telephone Company has been incorporated with a capital stock of $10,000 for the purpose of constructing a telephone line in this city. The incorporators are J. R. Thaxton, J. W. Thaxton and Chester White.

DEER WOOD, MINN.—Hamlet & Spirit Lake Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are Alfred Johnson, Alfred Heglund, F. V. Gerglund, C. M. Peterson, Gust J. Landstron, A. W. Nelson, N. J. Sherlund and Paul B. Bergfalk, all of Deer Wood.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SAN DIEGO, CAL.—The San Diego Electric Railroad Company is to expend $100,000 for heavier rails for the down-town streets.

OAKLAND, CAL.—The San Francisco-Oakland Terminal Railways has been granted a franchise for the extension of its line north on Euclid avenue, Berkeley.

ILCHESTER, MD.—It is announced that the Thistle Mills will install electric power for operating its plant within a short time.

WILLIAMSON, N. Y.—The Newark & Marion Railroad, it is rumored, will build a trolley line to Williamson in connection with the line already in operation between Newark and Marion.

INDIANAPOLIS, IND.—The Indianapolis, Crawfordsville & Danville Traction Company has made $2,000 increase in its capital stock, which, it is stated, is for the purpose of carrying on the extension of the line to Danville.

PORTLAND, IND.—C. L. Smith and associate capitalists are promoting an interurban road between Portland, Montpelier and Marion, and there is reason to believe that the road will be built. S.

HUNTSVILLE, ALA.—It is reported that the Huntsville Railway, Light & Power Company is planning to spend $75,000 to improve and extend its lines. E. L. Pulley is general manager of the company.

PADUCAH, KY.—The Kentucky Southwestern Railway, Light & Power Company, of Paducah, Ky., reports that rights of way for an interurban line in that section are being rapidly secured and that construction work may begin in the near future. G.

BENTLEYVILLE, PA.—A franchise has been granted to the Monongahela, Ellsworth & Washington Street Railway Company by this village to build an electric railway some 12 miles to the River Section, and it is announced that cars will be running within two years.

JONESBORO, ARK.—The Jonesboro & Nettleton Interurban Company has been organized with a capital stock of $15,000. Preston Hatcher is president and James B. Roleson, secretary, of the new company. The company will build and operate a street railway in this city and Nettleton.

EUGENE, ORE.—A. L. Watson, superintendent of the Portland, Eugene & Eastern Railway Company, is credited with the statement that all right-of-way obstacles have been removed and that the company will soon begin the construction of the long-talked of electric railway between Eugene and Monroe.

WHEELING, W. VA.—The Morgantown & Wheeling Railway Company has been incorporated to build a railway from Morgantown to Wheeling. The authorized capital is $1,000,000, and the incorporators are Julius Monroe and E. M. Lantz, of Kingwood, and John M. Gregg and D. M. Willis, of Morgantown.

SHELBYVILLE, KY.—The Kentucky Traction & Terminal Company, Lexington, Ky., is surveying a route between Frankfort and Shelbyville, Ky., and it is understood that an extension

between these points will be built. The company operates a line from Lexington to Frankfort as well as other lines to Central Kentucky points. G.

SAN JOSE, CAL.—The San Jose Terminal Railway Company has filed an application with the State Railroad Commission for permission to sell $950,000 in bonds and 350,000 shares of preferred stock of the par value of $1 per share, with the proceeds of which it is proposed to complete a combined electric and steamship line to connect San Francisco and San Jose. The length of the proposed line is 43 miles, 11 miles of which will be rail. Both passengers and freight are to be carried.

PROPOSALS.

LOCOMOTIVE, ELECTRIC, DIRECT-CURRENT.—Sealed proposals will be received by the Navy Department, Bureau of Supplies and Accounts, Washington, D. C., until June 18, for an electric, direct-current locomotive to be delivered at the Navy Yard, Washington, D. C., as per schedule 4599.

ELECTRIC PUSH-BUTTON LIFT.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until July 5 for an electric push-button lift for the post office at York, Pa., in accordance with specification, copy of which may be obtained from the office of the Supervising Architect.

GENERATORS AND CONDENSERS.—Sealed proposals will be received at the office of the United States Engineer, New London, Conn., until June 15 for turbine generators, condensers, synchronous converters (or motor generators), and voltage regulator. Further information may be obtained by application to A. E. Waldron, captain, engineers.

ELECTRIC LIGHTING SYSTEM.—Sealed proposals in triplicate will be received at the office of the Constructing Quartermaster, Fort Mason, Cal., until June 10 for installing an electric light distributing system at the Letterman General Hospital, Presidio of San Francisco, Cal. A deposit of $10 is required for the return of plans. Envelopes containing proposals are to be marked "Proposals for Electric Light System, Letterman General Hospital," and addressed to Lieutenant Colonel George McK. Williamson, deputy quartermaster general, United States Army.

ELECTRIC CONDUITS AND WIRING SYSTEM, AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising architect, Washington, D. C., for electric conduits and wiring system, and interior lighting fixtures until June 28, of a two-story and basement building for an extension of the post office at Reidsville, N. C.; until June 29, of a two-story and basement building for the post office at Austin, Tex.; until July 2, of a one-story building for an extension of the post office at Travers City, Mich.; until July 8, of a two-story and basement building for the post office at Portsmouth, O.; until July 9, of a one-story basement and mezzanine extension of the post office at Evanston, Ill.; until July 10, of a two-story and basement extension to the post office at Lansing, Mich.; until July 30, of a three-story and basement building for the post office at Billings, Mont. Drawings and specifications may be obtained from the custodian of the various sites or from the office of the Supervising Architect.

FOREIGN TRADE OPPORTUNITIES.

(*Parties interested in the following items should address the Bureau of Manufactures, Washington, D. C., and refer to the file number noted.*)

NO. 8853. TELEPHONE EQUIPMENT.—A European city is about to reorganize its telephone system and to establish 10 central stations. Only local firms will be allowed to compete for the orders to which this work will give rise, but such firms will be permitted to offer equipment materials from foreign countries. One local firm, which proposes to submit tenders, has informed an American consular officer that it desires to get in touch with firms in the United States wishing to offer equipment for centrals. Price lists with best terms should be sent immediately direct to this firm, as the tenders are to be made out during June. Correspondence on this subject addressed to the consular officer in question will also be delivered to other local firms of good standing.

NO. 8856. TRAMWAY MATERIALS.—The appropriations for the year 1912-13 for the Osaka, Japan, municipal electric tramways provide for the extension of the system by about six miles, and a large quantity of materials, to the extent of about $1,985,532, will be ordered from foreign sources. The principal items will include rails, motors, brakes and other truck apparatus, and copper wire. Bridge material is also likely to be required.

NO. 8859. WIRELESS - TELEGRAPH STATIONS.—The Post and Telegraph Department, St. Petersburg, Russia, will accept tenders for wireless-telegraph stations on the White and Kara Seas, at an estimated cost of $51,000.

NO. 8863. MOTOR GENERATOR AND GENERATOR SETS. — The Railways and Tramways Department, Sydney, Australia, will receive tenders until July 1 for one 200-kilowatt motor generator set; until July 15 for two 120-kilowatt motor generator sets. Specifications Nos. 342 and 344 may be obtained of the Electrical Engineer, Hunter Street, upon payment of 60 cents.

NO. 8865. CABLE.—The Postmaster General, Melbourne, Australia, will receive tenders until June 18 for 50.5 miles paper-insulated lead-covered cable (No. 717).

NEW INCORPORATIONS.

SPOKANE, WASH. — Commercial Electric Company has been incorporated with a capital stock of $10,000 by E. S. Thurston, J. I. Price and others.

CHICAGO, ILL.—Illinois Electric Motors Manufacturing Company has been incorporated with a capital stock of $5,000 to manufacture and sell electric motors and electrical supplies.

NEW YORK, N. Y.—Philadelphia Gas & Electric Fixture Company has been incorporated with a capital stock of $10,000. The incorporators are Samuel Augenblick, Louis B. Brodsky, New York City, and Celia Rothstein, Brooklyn.

PEEKSKILL, N. Y.—Sproul Equipment Company has been incorporated with a capital stock of $50,000 to engage in electrical contracting. Harvey B. Sproul, Alma J. Sproul and Allen Roraback, all of Peekskill, are the incorporators.

OWEGO, N. Y.—The H. M. Hirschberg Company has been incorporated with a capital stock of $25,000 to manufacture arc lamps, fixtures, etc. The incorporators are William Huck, Jr., Arthur W. Dalton, Joseph Gerrardt, all of New York City.

NEW YORK CITY.—Maloney Electric Company has been incorporated with a capital stock of $700,000 to manufacture electric supplies. The incorporators are J. J. Mullin, David May, of St. Louis, Mo., and L. D. Shoenberg, of New York City.

NEW YORK, N. Y.—Tennessee Natural Development Company has been incorporated with a capital stock of $20,000 to engage in the manufacture of electricity. The incorporators are John K. Byard, Walter H. Pollack, New York City, and George H. Burt, Brooklyn.

FINANCIAL NOTES.

Bank clearances continue to reflect the steady return to normal business conditions. Railroad gross tonnage shows good expansion over the tonnage of the corresponding periods of last year. In the metal trades the improvement has been marked. Current business in metals is of exceptionally large volume, notwithstanding that May is usually a dull month.

Net earnings of National Carbon Company are showing a very decided recovery from the depression which characterized operations for the fiscal year to December 31. For the quarter to April 1 net profits from operations were in excess of $225,000, an increase of 40 per cent over the same period a year ago. If continued for the full year, this rate of gain would mean net profits for the $5,500,000 common of close to 15 per cent which compares with 11 per cent for the late year.

The common stock has recently advanced to a high point of 120, up 17 from the low mark of the year.

National Carbon has so charged down its accounts, carrying, for example, its plants at less than 45 per cent of their actual cash cost, that there are many who believe that an extra distribution of some sort to the common stockholders will not be postponed long after the opening of the 1913 year.

Gross sales of Westinghouse Electric have been making a most satisfactory expansion during the past three months. March gross was about $3,000,000, followed by a further increase to $3,500,000 in April, and May sales have been running at a rate in excess of $4,000,000. The strong showing this month has of course been helped out by the receipt of a big order for about $1,000,000 of apparatus from the New Haven Railroad. At the same time there has been a progressive improvement, and orders now on hand equal three months' output compared with but about two months when the fiscal year closed March 31.

The Continental & Commercial Trust and Savings bank of Chicago filed a bill in the United States District court against the Allis-Chalmers Company, asking foreclosure of the $15,000,000 mortgage.

The proceedings follow by a few weeks the appointment of receivers for the company on application of Mil-

waukee stockholders and the placing in operation of the reorganization plan. This plan was acceded to by 80 per cent of the bondholders and two-thirds of the holders of the $19,820,000 common and $16,050,000 preferred stock.

The Continental asks for the appointment of receivers for the property covered in the first mortgages and all property involved turned over to them by the receivers named last month. It asks that the deed of trust be affirmed and that the company be directed to pay principal and interest in full. This payment failing, the property is to be sold under the bill, but sold in one parcel, the bank being allowed to bid for it in the interest of the bondholders who join the agreement. Incoming revenues are to be applied under direction of the court to the property.

It is too early to note what has been accomplished by the receivers, but it is understood that business had improved and that with the reorganization of the excellent facilities of the company, the outlook was brighter than for a long time heretofore.

An official of the United States Light & Heating Co. says: "This week more than 35 automobile manufacturers have called at our Niagara Falls plant to inspect the new self-starter and lighting motor device. Last week one manufacturer placed an order for equipment of 30,000 motor cars with this accessory, the largest single order for motor accessories ever placed.

"Not only does this bring new business, forcing an addition to the present plant to cost $300,000 to $350,000, but our business in all lines is increasing."

Regarding the formation of the Middle West Utilities Company, of Chicago, by the Insull interests, Martin J. Insull, general manager of the United Gas & Electric Company, the Louisville and Northern Railway & Lighting Company and the Louisville & Southern Indiana Traction Company, of New Albany, Ind., said that no change will be made in the operation of these corporations. It is believed that the new company will be used for holding purposes and that the securities of the Insull properties in Southern Indiana and elsewhere will be taken over by it and new issues provided for.

Minority stock of the Louisville Lighting Company, owned by W. S. Sheehan, N. F. Brady, and others of New York City, has been turned over to the Byllesby interests of Chicago, which control the company through their ownership of majority holdings in the Louisville Gas Company. The latter has controlled the Louisville Lighting Company, but about 9,000 shares of stock were held by the interests referred to. These have agreed to sell on a basis of $65 per share and the change will make the lighting company entirely subsidiary to the gas corporation.

Announcement has been made that the Louisville Lighting Company has an option on the plant and franchise of the George G. Fetter Lighting & Heating Company, of Louisville. As the option will expire in the next few days, it is likely that it will be closed at once and the property added to the holdings of the Louisville Lighting Company. The Fetter Company secured a franchise and put its plant in operation only a short time ago and is serving a considerable number of commercial consumers in the central district covered by its franchise. An ice factory is operated in connection with the lighting plant, which is located at Bullitt and Water Streets. George H. Harries, president of the Louisville Lighting Company, in discussing the prospect of the Fetter Company being taken over, indicated the belief that all of the heating and lighting companies of Louisville will be brought into one corporation in the near future. George G. Fetter is president and J. Hoadley Cochran is chief engineer of the Fetter Company.

April gross earnings of the Massachusetts Lighting Companies were $63,801, an increase of $5,805, or 9.09 per cent over the corresponding month a year ago.

New York bankers have purchased the minimum amount of $3,730,000 ten-year five-per-cent notes to be issued by the Central States Electric Corporation in acquiring about sixty per cent of the Cleveland Electric Illuminating Company common stock at $130 per share.

A first mortgage, covering $2,000,000 five-per-cent bonds maturing in 1922, has been filed in Mahoning County, Pa., by the Republic Construction Company, which gives as security the proposed $1,500,000 power station at Lowellville and property in Youngstown. The Republic company is a newly organized subsidiary of the Mahoning & Shenango Railway & Light Company.

The Republic Construction Company, a subsidiary of the Republic Railway & Light Company, controlling lighting and electric plants and trolley systems in this section, has been authorized to increase its capital stock from $1,000 to $2,000,000. The company plans important improvements to its properties. Recently stockholders authorized a bond issue of $55,000,000.

The Edison Company of Boston offers 26,007 shares of new stock, if authorized by Gas Commission, to stockholders at $215 a share in ratio of one new for each six now held, to pay for extensions of plant. Subscription price is the same as for previous issue in January, 1910, when 19,452 shares were offered in ratio of one for seven.

Holders of Keystone Telephone common stock will be asked to renew the present voting trust, which expires July 1, of the $5,000,000 common stock, of which $2,750,000 is deposited with the five voting trustees. The renewal of the voting trust is not intended to bring about any change in the object of the present trust, but merely to continue the status unchanged.

Dividends.

American Telegraph & Cable Company; the regular quarterly dividend of 1.25 per cent, payable June 1 to stock of record May 31.

Mackay Companies; a quarterly common dividend of 1.25 per cent, and a preferred dividend of one per cent, payable July 1 to stock of record June 8.

Norfolk Railway & Light Company; a semi-annual dividend of 2.5 per cent, payable June 10 to stock of record May 31.

Northern Ohio Traction & Light Company; a quarterly common dividend of one per cent, payable June 15 to stock of record May 31.

Rochester Railway & Light Company; a quarterly preferred dividend of 1.25 per cent, payable June 1 to stock of record May 25.

Virginia Railway & Power Company; a semi-annual preferred dividend of 2.5 per cent, payable July 10 to stock of record June 22.

Reports of Earnings.

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for April and four months ended April 30, compares as follows:

	1912.	1911
April gross	$ 316,138	$ 320,329
April net	306,005	310,220
Four thousand gross	1,343,347	1,387,041
Four thousand net	1,301,628	1,349,891

ELECTRICAL PROPERTIES.

The Electrical Properties Company has issued its report for the year ended April 30, 1912. The income account compares as follows:

	1912	1911
Total income	$ 97,816	$251,841
Expenses, taxes, etc	34,115	62,101
Net income	63,701	189,740
Preferred dividends	.....	.....
Surplus	63,701	189,740
Profit and loss reductions	505	51,103
Previous surplus	231,618	92,981
Profit and loss surplus	294,814	231,618

UNITED ELECTRIC LIGHT.

The United Electric Light & Power Company (controlled by Consolidated Gas Company) has made a report to the New York Public Service Commission for the year ended December 31, 1911, which compares as follows:

	1911.	1910.
Operating revenue	$2,309,337	$2,109,242
Expenses and taxes	1,213,733	1,080,174
Operating income	1,095,603	1,029,069
Other income	16,669	20,144
Total income	1,112,272	1,049,213
Charges	737,718	731,033
Net income	374,553	318,180
Renew. and conting	308,338	250,843
Profit and loss debit	35,637	*193,093
Previous deficit	565,810	826,240
Profit and loss deficit	535,231	565,810

*Credit.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK

	May 27.	May 20.
Allis-Chalmers common (New York)	1	1
Allis-Chalmers preferred (New York)	2	2
American Tel. & Tel. (New York)	145½	145¾
Commonwealth Edison (Chicago)	141½	141
Edison Electric Illuminating (Boston)	282	292
Electric Company of America (Philadelphia)	12¼	12¼
Electric Storage Battery common (Philadelphia)	55½	55¾
Electric Storage Battery preferred (Philadelphia)	55½	55¾
General Electric (New York)	170	169½
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	2⅞	2¼
Massachusetts Electric common (Boston)	20½	19½
Massachusetts Electric preferred (Boston)	*95	*95
National Carbon common (Chicago)	119	115
National Carbon preferred (Chicago)	117	116
New England Telephone (Boston)	152	153¾
Philadelphia Electric (Philadelphia)	19¼	19⅝
Postal Telegraph and Cables common (New York)	84	83½
Postal Telegraph and Cables preferred (New York)	69	69
Western Union (New York)	83¾	82¾
Westinghouse common (New York)	73	73¾
Westinghouse preferred (New York)	116	117

*Last price quoted.

PERSONAL MENTION.

H. T. EDGAR, manager of the Seattle Electric Company, has been appointed manager of the Seattle Division of the Puget Sound Traction, Light & Power Company.

ARTHUR G. KINGMAN, of the Western Electric Company, has recently been promoted by his company, being transferred from the Philadelphia office to the New York office.

W. A. WADSWORTH, formerly engineer for the Schenectady (N. Y.) Illuminating Company, now represents the Electric Bond & Share Company in its development in Northern Alabama.

HARRY V. COFFY, formerly secretary to Arthur S. Huey, vice-president of H. M. Byllesby & Company, Chicago, has been appointed assistant to W. H. Hodge, manager of the publicity department.

O. V. MAURER, formerly factory superintendent of the Cleveland Miniature Lamp Works of Cleveland, O., has been appointed manager of the New York Miniature Lamp Works of General Electric Company.

T. C. ROBERTS, superintendent and chief engineer of the Arkansas Valley Railway, Light & Power Company, Pueblo, Colo., has been appointed construction superintendent of the Byllesby properties in that territory.

L. A. HAWKINS, of the Research Laboratory, General Electric Company, Schenectady, N. Y., made an address on "Industrial Research" before the annual meeting of the Armour Institute of Technology Alumni Association in Chicago, on May 28.

A. B. LEIGHTON, formerly superintendent of the Dover, Somersworth & Rochester Street Railway Company, Haverhill, Mass., has become associated with the Malden Electric Light Company, with headquarters at Malden, Mass.

W. I. WARRINER, of the Lakewood (N. J.) Water, Light & Power Company, has been placed in general charge of the commercial work of the new-business department of the Long Island Lighting Company, with headquarters at New York City.

E. LEAVENWORTH ELLIOTT, who has been editor of the *Illuminating Engineer*, of New York, since its foundation in 1906, has resigned his position to concentrate his energies as a consulting illuminating engineer. Mr. Elliott has been one of the pioneers in the movement for improved lighting.

G. WILBUR HUBLEY, chief engineer of the Louisville Lighting Company, addressed the Engineers' and Architects' Club of Louisville, Ky., recently, and defended the accuracy of the meter for electricity, water and gas, which is frequently impugned by newspapers and others.

HUGH L. COOPER, vice-president and chief engineer of the Mississippi River Power Company, delivered an illustrated lecture on the Keokuk hydroelectric project before the annual banquet of the Alumni Association of Armour Institute of Technology, which was held at the Hotel Sherman, Chicago, on May 28.

JOSEPH M. ENRIGHT has been promoted to the position of manager of the Railway Department of the Toledo Railways & Light Company, Toledo, O. Mr. Enright started with this company in 1888, since which time he has climbed step by step until he has reached the office to which he was recently appointed.

W. H. WILMARTH, manager of the Sapulpa Electric Company, has been elected director of the Commercial Club of that city. This is in line with the policy of H. M. Byllesby & Company, managers of the property, who require the local managers of their various utilities to actively engage in all civic matters.

ROBERT GRINNELL has been appointed general superintendent of the electric railway lines in the City of Mexico, Mex. Mr. Grinnell at one time was assistant superintendent of transportation of the Chicago City Railways Company, later becoming identified with the Illinois Tunnel Company, Chicago, Ill.

H. K. ANNIN, until recently engaged in commercial engineering work with the engineering department of the National Electric Lamp Association at Cleveland, has left this post to assume the managership of the Elux Miniature Lamp Works of General

H. K. Annin.

Electric Company in New York City. Mr. Annin has a wide acquaintance among the miniature-lamp trade, particularly the buyers of automobile lamps, and this, coupled with his technical knowledge of the miniature-lamp business, makes him particularly fitted to conduct successfully the duties of his new position.

T. L. MILLER, of New York City, has been appointed assistant to the president, and efficiency engineer of the Toledo Railways & Light Company, with headquarters at Toledo, O. Mr. Miller after graduating from Mechanical Engineering Department of Cornell University became associated with the Carnegie Steel Company, afterwards connecting himself with Marwick, Mitchell & Company, cost accountants and efficiency engineers of New York City, in whose employ he assisted in installing a cost system at the Buick Automobile Company, Flint, Mich.

H. M. HIRSCHBERG has returned from Europe and announces that he has arranged with the Siemens-Schuckertwerke, G. m. b. H., Berlin, to manufacture a specially designed flaming-arc lamp for the American market. These lamps, which include the regular 10 and 17-hour converging type and a new vertical 40-hour type of flaming arc, can be operated for both white and yellow light. The reputation and size of the factories controlled by Siemens-Schuckertwerke, employing 66,000 hands, warrant the claim that these lamps will have many improvements which will establish their success in this country. In addition to these lamps, Mr. Hirschberg states that he will continue to carry a full line of Plania carbons, as heretofore.

OBITUARY.

ROBERT HOWLAND ORTON, son of William Orton, once president of the Western Union Telegraph Company, died on May 22, at his home at Irvington-on-the-Hudson, N. Y.

PAUL DE LA COUR, a Danish electrical engineer of prominence, has died at the age of 33 years from an operation due to appendicitis. For some years he was assistant to the late Professor Arnold at Karlsruhe, Germany, afterwards going to Russia. Since 1905 he has been chief designer for Bruce, Peebles & Company, Edinburgh, Scotland.

DATES AHEAD.

National Electric Light Association. Annual convention, Seattle, Wash., June 10-14.

National Railway Electrical Engineers' Association. Atlantic City, June 12-19.

Minnesota Electrical Contractors' Association. Annual convention, Duluth, Minn., June 16.

Canadian Electrical Association. Annual convention, Ottawa, Ont., June 19-21.

Michigan Section of the National Electric Light Association. Annual convention on board the *Majestic*, sailing from Port Huron, Mich., on June 21.

National District Heating Association. Annual convention, Detroit, Mich., June 25-27.

American Institute of Electrical Engineers. Annual convention, Boston, Mass., June 25-28.

Society for the Promotion of Engineering Education. Annual meeting, Boston, Mass., June 26-29.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 16-19.

Ohio Electric Light Association. Annual convention, The Breakers, Cedar Point, O., July 17-19.

International Association of Municipal Electricians. Annual convention, Peoria, Ill., August 26-30.

International Association for Testing Materials. Sixth congress, New York City, September 3-7.

Association of Iron and Steel Electrical Engineers. Annual convention, Hotel Pfister, Milwaukee, Wis., September 16-21.

The 1912 Boston Electric Show, Mechanics Building, Boston, Mass., September 28-October 26.

American Electric Railway Association and its five affiliated associations. Annual convention, Chicago, Ill,. October 7-11.

New England Section of the National Electric Light Association. Fall convention, Boston, Mass., October 10-11.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Manhattan, Kans., October 17-19.

With the Electrical Manufacturers

The Bridgeport Brass Company, Bridgeport, Conn., is sending out cards showing the adaptability of its Phono-electric trolley wire for any type of overhead trolley construction.

The Flint Extension Light Company, Flint, Mich., is distributing a pamphlet describing its Woods motor-car extension light which is designed to be connected to the ignition battery of an automobile.

The Walpole Rubber Company, operating the Massachusetts Chemical Company, Walpole, Mass., which for a long time has been well known as a manufacturer of liquid and rubber insulation, has now added to its products a complete line of rubber clothing.

Ray D. Lillibridge, Incorporated, has moved its offices to the twenty-first floor of the Trinity Building, 111 Broadway, New York City. This organization specializes in technical advertising and has a number of prominent electrical manufacturers among its many clients.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued several new sections for its catalog No. 3002. These relate to types S and SA elevator motors, CCL alternating-current motors, MA mill motors, SK generators and type G multi-switch starters.

Habirshaw Wire Company, 253 Broadway, New York City, has published an "Insulated Wire Catechism," which brings out in a very pithy manner some important facts regarding wire insulation in general, and the new Code standard of insulated wire manufactured by this company.

The Indirect Light & Fixture Company, 36 West Randolph Street, Chicago, is sending out circulars showing several of its designs of indirect fixtures. These are of composite material and furnished in a variety of finishes. Special stamped-steel white-enameled reflectors are used in the fixtures.

Frank Adam Electric Company, 904 Pine Street, St. Louis, Mo., has published its general catalog No. 18. This is a well-bound book of 194 pages that shows the extensive line of knife switches of all kinds, panel boards, feeder connections, cabinets, switchboard material and switchboards manufactured by this company.

The H. W. Johns-Manville Company, New York, N. Y., has issued a folder describing the Audiffren-Singrun refrigerating machine, which is a small electrically driven machine, for residences, restaurants, small hotels, meat markets, dairies, etc. It is built in four sizes requiring one-half to four-horsepower motors.

Western Electric Company, New York, N. Y., has prepared a series of 12 photographic postcards showing views in its Hawthorne works, Hawthorne, Ill. Among the views shown are the lead press room of the cable plant, the telephone apparatus shops, a corner of the switchboard-wiring department, the building up of cable cores, etc.

The Bristol Company, Waterbury, Conn., has issued catalog No. 1000, which is devoted to Bristol's recording pressure and vacuum gauges. This is a 64-page bulletin that describes and illustrates the great variety of these gauges manufactured by this company, shows typical record charts and gives a partial list of over 2,000 users of these instruments.

The Hanson & VanWinkle Company, Newark, N. J., has sent out circulars calling attention to its balancing tool, which is used for balancing polishing wheels, pulleys, cones and armatures. Another circular calls attention to the new line of welded steel tanks made by the company especially for electric cleaning and plating operations involving the use of hot cyanide, potash and other similar solutions.

The Naugle Pole & Tie Company, 5 South Wabash Avenue, Chicago, Ill., has prepared a little booklet giving the specifications adopted by the Northwestern Cedarmen's Association for white cedar poles. A number of inspection comments on these standard specifications are also given. In this booklet are also shown some typical views in the extensive pole yards of the company in Chicago, Ill., and Pinconning, Mich.

Diehl Manufacturing Company, Elizabethport, N. J., has prepared bulletin No. 130, which describes and illustrates its type CM vehicle motors and controllers for use with electric motor trucks and pleasure cars. A complete line of these motors has been standardized, covering practically all sizes from the smallest unit to the heavy-duty type for a ten-ton truck. The company has organized a special department for the production of these motors.

W. N. Matthews & Brother, St. Louis, Mo., announce that they have engaged the services of Warren M. Heim, formerly constructing engineer for E. L. Phillips & Company, New York. Mr. Heim will have the position of sales engineer in charge of the eastern office of the firm at 227 Fulton Street, New York City, where he will devote all his time to the marketing of the numerous Matthews patented time, labor and money-saving electrical specialties.

The Electric Appliance Company, Chicago, Ill., states that there is a considerable increase in the demand for the "A.-W. Mazda Street Series Regulator" This regulator is now made in the pole type and it has been installed with entire satisfaction by a number of central stations on their high-tension lines. The company is preparing a new bulletin describing the latest features of the regulator, and containing also some interesting and valuable data on street series lighting systems. Copies of this bulletin will be furnished upon request.

Fancleve Specialty Company, Jamaica Plain Station, Boston, Mass., has issued its new 36-page catalog of wiring fittings. This catalog is unique in giving not merely a list and illustrations of its products, but in showing a variety of wavs how they are installed and giving detailed instruction for this purpose. The company has developed some 700 fittings in its 25 years of experience in this line. Among the fittings described in the catalog are fittings for metal and wood molding, for armored cables, rigid and flexible metallic and non-metallic conduits.

Electric Storage Battery Company, Philadelphia, Pa., has prepared a service-organization map, which shows graphically the location of its sales offices, Exide depots and store rooms, construction-department branches, operating-department branches and Exide inspection offices in all parts of the country. The company is sending out colored postcards showing its enlarged main works at Philadelphia. Since the addition of its new building these works cover a total of 12.25 acres of floor space devoted exclusively to the manufacture of storage batteries and their accessories.

Pass & Seymour, Incorporated Solvay, N. Y., is sending out copies of bulletin No. 720, which is just off the press. This is devoted to outdoor display illumination and outline lighting and the series of wired sign receptacles, porcelain sockets, mica sockets and other fittings that are conveniently arranged for such work. The frontispiece shows the Roman Catholic Cathedral in New York City as it was illuminated for the return of Cardinal Farley last fall. The back cover of the bulletin shows the illumination of the Denver Gas & Electric Light Company's building.

The General Electric Company, Schenectady, N. Y., has issued several interesting and well illustrated new bulletins. No. 4931 is entitled "Electricity in the Shoe and Leather Industry" and describes a number of installations of this nature. Bulletin 4939 on electric hoists shows the great variety of hoisting equipment that can very successfully be operated by electric motors and describes the electric hoists manufactured by the company. Bulletin 4947 is devoted to the illumination of electric railway cars and the advantages possessed by Edison Mazda and Gem lamps for this service. This bulletin contains illustrations showing the illumination of cars by these two types of lamps as compared with that resulting from the use of the old carbon-filament lamp.

Record of Electrical Patents.

Issued by the United States Patent Office, May 21, 1912.

1,026,653. Combination Spark Plug. W. C. Brunt, Boston, Mass. Includes a special connector with a handle and bifurcated end.

1,026,660. Sighting Apparatus for Ordnance. A. T. Dawson and G. T. Buckingham, assignors to Vickers, Ltd., Westminster, London, Eng. An electric motor is geared to the moving pointer.

1,026,673. Magnetic Separator. F. C. Heinen, Chicago, Ill. A rotatable cylinder with radial poles pointing inwardly.

1,026,689. Trolley-Harp. P. A. McCullough, Pittsburgh, Pa. Relates to the bearings and lubrication for the trolley wheel.

1,026,690. Cord-Adjuster for Electric Lamps. J. McGavin, Springfield, Ill. Includes a ball, a cord keeper and spring, and a lifter.

1,026,711. Sheet-Metal Insulator Pin. B. R. Shover, Youngstown, O. The sheet is longitudinally slitted and bent to form a number of tongues over which the insulator screws.

1,026,722. Heating. W. I. Thomson, Newark, and H. G. Thompson, Glen Ridge, N. J., assignors to Safety Car Heating & Lighting Co. A steam boiler with electric heating coils in the submerged part of the vertical tubes.

1,026,733. Process for Casting Metals. F. D. Buigne, Magdeburg, Germany. The bath is electrically heated between internal electrodes.

1,026,737. Dynamo-Electric Machine. W. W. Dean, assignor to Dean Electric Co., Elyria, O. A magneto with rocking bar magnets.

1,026,763. Cash Register. W. H. Muzzy, assignor to National Cash Register Co., Dayton, O. Has an electric alarm operated by opening each cash drawer.

1,026,769. Fire-Signal Device. C. Raymond, Windsor, Conn. Fusing of a wire closes electric bell and lamp circuits.

1,026,775. Current Regulator. W. H. Sherbondy, Fort Wayne, Ind. Heating of a conductor in a tube causes a decrease of pressure on an adjoining carbon-plate resistance pile.

1,026,779. Annunciator or Indicator. W. S. Woodruff, New York, N. Y. A carriage call in which the numbers are controlled by electromagnets and raised by an electric motor.

1,026,798. Variable-Resistance Means. E. R. Gill, Yonkers, N. Y. A resistance box with binding posts at the terminals of each coil to permit any coil to be used alone or in series with others or to be short-circuited.

1,026,827. Propulsion of Motor Vehicles. H. Pieper Liege, Belgium. A control system for a shunt-motor-driven electric vehicle.

1,026,847. Cover for Electric Batteries. H. J. Brewer, New York, N. Y. Has means for supporting the electrodes.

1,026,848. Electric Lighter for Gas Burners. S. Brown, Chicago, Ill. For acetylene burners.

1,026,850. Telephone Trunking System. F. M. Davis, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Relates to the lamp-signal system.

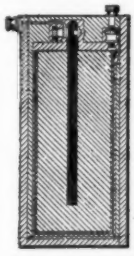
1,026,857. Electrolytic Apparatus. L. G. Fixen, Chicago, Ill. Has a central and two end electrodes with a number of intervening partitions.

1,026,862. Electric Water-Heater. E. M. Hengell, San Francisco, Cal. An immersion heater with a helical coil spirally arranged between cross bars.

1,026,874. Overhead Trolley. A. P. Lord, C. A. Lindberg, and J. V. Flanigan, Bradford, Pa.; said Lord and Lindberg, assignors to said Flanigan. Has special oiling means in the harp.

1,026,900. Apparatus for Regulating Dynamo-Electric Machines. C. E. Bonine, assignor to Electro-Dynamic Co., Bayonne, N. J. A motor-control system including means for shunting sections of the main poles without affecting the commutating poles.

1,026,904. Electric Motor. J. Burke, assignor to Burke Electric Co., Erie, Pa., A combined portable blower and motor with an end cap that closes the motor circuit when it is applied.



1,027,088.—Waterproof Dry Cell.

1,026,905. Clock-Operated Electric Switch. F. P. Cauble, High Point, N. C. The clapper of an alarm clock is connected by a cord to the trigger of the switch.

1,026,906. Electric Car Signal. E. B. Chapman, Chicago, Ill. Each controller has its reversing drum connected to a set of signals to indicate the direction the car will take.

1,026,924. Electrical Safety-Lamp for Miners. V. V. Patton, Tollarburg, Colo. Has a collapsible casing held in normal condition by a spiral spring.

1,026,955. Trolley Retriever. S. P. Kay, assignor of one-third to G. F. Roth, one-third to F. B. Graves, Rochester, N. Y., and one-sixth to A. Kay. Operates on the lower end of the trolley pole.

1,027,011. Fire-Bucket Support. M. A. Stewart, Newark, N. J. Leakage or evaporation of the water in the bucket lowers a float that closes an alarm circuit.

1,027,023. Magneto. E. C. Wilcox, assignor to Connecticut Telephone & Electric Co., Meriden, Conn. An induction coil, condenser and vibrator are combined with the magneto.

1,027,046. Block-Signal System. L. A. Hawkins, Schenectady, N. Y., assignor to Union Switch & Signal Co. Currents of different frequencies are supplied to the track circuits.

1,027,047. Automatic Train Stop. L. A. Hawkins, assignor to Union Switch & Signal Co. Increase in reluctance of a horseshoe-shaped magnet coil carried by the train, as when it passes along a non-magnetic track section, operates the stop.

1,027,048. Electric Motor. L. A. Hawkins, assignor to Union Switch & Signal Co. A signal motor with a brake associated with its shunt field to effect instantaneous stopping.

1,027,053. Combined Automatic Telephone-Exchange and Fire-Alarm System. J. W. Lattig and C. L. Goodrum, assignors to American Automatic Telephone Co., Rochester, N. Y. The subscribers' lines have special signal wheels to send code numbers over the lines to the automatic alarm switches.

1,027,072. Electric Controller. W. Schwieder, assignor to Commonwealth Steel Co., St. Louis, Mo. A reversing switch for the armature of a series motor.

1,027,073. Electric Locomotive. F. L. Sessions and F. C. Coseo, Columbus, O., assignors to Jeffrey Manufacturing Co. A mining locomotive adapted for ordinary or rack-rail service.

1,027,074. Rack-Rail Locomotive. F. L. Sessions, assignor to Jeffrey Manufacturing Co. An amplification of the above relating to the change-speed gearing.

1,027,075. Locomotive. F. L. Sessions, assignor to Jeffrey Manufacturing Co. A further amplification relating to the clutch mechanism.

1,027,077 and 1,027,078. Rack-Rail Locomotive. F. L. Sessions, assignor to Jeffrey Manufacturing Co. Refers to the differential and spur gearing between the motor and drive wheels.

1,027,088. Waterproof Battery and Method of Making Same. R. V. Villiers, East Freetown, Mass. A dry cell entirely incased in cement.

1,027,090. Current-Collecting Mechanism. C. J. E. Waxbom, assignor to Jeffrey Manufacturing Co. A manually operated hook to bear against the trolley wire instead of a wheel.

1,027,101. Regulator for Dynamos. W. H. Chapman, Portland, Me. An automatic means for stepping the field-rheostat arm.

1,027,103. Trolley-Contact. F. T. Cope, Alliance O. Includes a pair of metal rods and a pair of movable contact strips secured thereto.

1,027,104. Elevating or Separating Jack for Electrical Cables or Wires. T. J. Cope, Philadelphia, Pa. Has means for swingingly raising the upper or movable jaw.

1,027,126. Safety Device for Electric Hoists. J. H. Hall, assignor to Electric Controller & Manufacturing Co., Cleveland, O. Shunts the motor armature when power is cut off or the motor speed becomes excessive.

1,027,129. Electric-Controller Crank. G. E. Henry, Vincennes, Ind. Relates to details of construction.

1,027,145. Dynamo-Electric Machine. J. E. Noeggerath, assignor to General Electric Co. Relates to the collector rings of a unipolar generator.

1,027,147. Panel Board. R. H. Olley, assignor to Crouse-Hinds Co., Syracuse, N. Y. Covers the method of mounting the fuse-plug sockets.

1,027,159. Motor-Control System. J. A. Seede, assignor to General Electric Co. An adjustable relay automatically varies the motor-field strength.

1,027,162. Non-Consuming Arc-Lamp Electrode. E. Weintraub, assignor to General Electric Co. A positive electrode has an iron sleeve shrunk on it and a magnesia mantle resting on top of the sleeve.

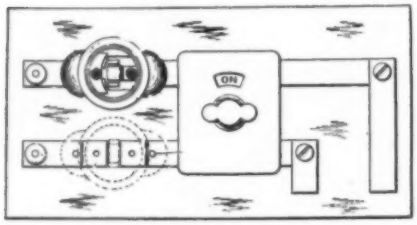
1,027,165. Method of Treating Filaments. H. I. Wood, assignor to General Electric Co. Wire made from cadmium amalgam impregnated with tungsten is baked to drive out the mercury.

1,027,166. Punka Fan. J. D. Andrews, London, Eng. An electromagnet oscillates a pivoted armature to which the pen is attached.

1,027,167. Flash-Light Apparatus. W. T. Barnum, Chicago, Ill. The powder is electrically ignited.

1,027,169. Battery Zinc. J. Beattie, Leete Island, Conn. Comprises an amalgam of zinc, mercury and sodium.

1,027,175. Trolley. S. Brauner, Pittsburgh, Pa., asisgnor of one-third to J. M. Schwartz. Has an auxiliary trolley wheel back of the main wheel.



1,027,147.—Panel Board.

1,027,230. Railway Signal Apparatus. J. H. Alandar, Chicago, Ill. Provides an electrical contact next to the rail which is selectively operated by trains moving in one direction only.

1,027,238. Receiver for Electromagnetic Waves. E. R. Carlson, Brooklyn, N. Y., assignor of one-third to M. Katsky. Includes electrolytic fluid and mineral containers and a bracket holding a pin one of whose ends is adapted to contact with the fluid and the other with the mineral.

1,027,239. Telephone-Exchange System. E. E. Clement, Washington, D. C. Relates to the relay control of the line and supervisory lamps.

1,027,240. Electrical Contact. E. E. Clement, Washington, D. C. A rivet contact point for circuit-changing springs is coated with non-oxidizing metal.

1,027,272. Alarm for Boxes and Other Receptacles. S. Mundler, London, Eng. Moving or lifting a cash box displaces a ball and closes an electric bell circuit.

1,027,273. Dynamo-Electric Machine. W. Nelson, Philadelphia, Pa. Relates to the clutch connecting an internal-combustion engine and the adjoining dynamo.

1,027,279. Electric-Line-Tapping Connector. J. F. Richardson, Montreal, Que., Can. A fixed and a loose hook are mounted on a tubular pole carrying the circuit wires to the instrument.

1,027,281. Trolley. S. Rogowski, Harmony, R. I. The harp is flexibly mounted to the bent top of the trolley pole.

1,027,291. Electric Heater. W. Stanley, assignor to General Electric Co. Relates to heat-insulating features of the electric storage range.

1,027,295. Signal Device. W. Thorsteinson, Winnipeg, Man., Can. A thermometer provided with high and low-temperature electric alarm.

1,027,299. High and Low-Water Alarm Apparatus. A. R. Walls, Gypsy, W. Va. An electric alarm for a hot-water system.

1,027,306. Automobile Lamp. P. C. Avery, Milwaukee, Wis. An incandescent lamp mounted at the focus of a parabolic reflector.

1,027,337. Electrical Heating Device. Frank J. Holmes, assignor to Vulcan Electric Heating Co., Chicago, Ill. A soldering iron with the heating coil around a copper core.

1,027,343. Automatic-Block-Signal Joint. L. H. Kinney and W. McGuire, Clifton, Pa. An insulated rail joint.

1,027,351. Electric Signal-Receiving Appliance. J. G. Mitchell, assignor to North Electric Co., Cleveland, O. Consists of a horn, a diaphragm, a permanent and an electromagnet.

1,027,376. Telegraph Transmitting-Machine. E. d. A. d. V. Atiles, San Juan, Porto Rico. Includes an electrically operated transmitting-key actuator.

1,027,392. Telephone-Exchange System. J. L. Wright, assignor to North Electric Co., Cleveland. Includes a special means of testing automatic telephone lines for "busy" condition.

Reissue.

13,421. Machine for Reseating Valves. R. H. Hazeltine, New York, N. Y. Original No. 918,049, dated April 13, 1909. Includes an electromagnetic valve holder.

Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired May 28, 1912.

539,786. Conduit Electric Railway System. F. Barrell, New York, N. Y.

539,804. Electromagnetic Gold Separator. J. D. Gibbens and W. B. Murray, Portland, Ore.

539,825. Electrical Connection. P. Rieth, Chicago, Ill.

539,838. Process of Procuring Incandescent Bodies for Electric Lamps. K. O. E. Trobach, Pankow, Germany.

539,840. Safety System for Railways. A. L. Ware, Cambridge, Mass.

539,849. Electric Motor. J. B. Atwater, Chicago, Ill.

539,854. Trolley Breaker. W. G. Carey and A. A. Ball, Jr., Schenectady, N. Y.

539,863. Controller for Electric Searchlight. E. F. G. H. Faure, J. MacHaffie, and S. H. Libby, Schenectady, N. Y.

539,870. Annunciator. E. A. Jennings, Ithaca, N. Y.

539,871. Galvanic Battery. H. T. Johnson, New York, N. Y.

539,876. Stationary Transformer. W. S. Moody, Lynn, Mass.

539,877. Electric Arc Lamp. J. A. Mosher, Chicago, Ill.

539,881. Armature Coil and Method of Making Same. O. F. Persson, and D. P. Thomson, Schenectady, N. Y.

539,886. Electric Meter. E. Thomson, Swampscott, Mass.

539,939. Electric Cable. W. D. Gharky, Philadelphia, Pa.

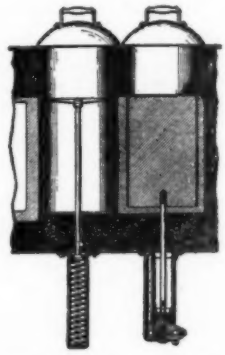
539,943. Armature Winding and Method of Making Same. W. Hochhausen, Brooklyn, N. Y.

539,959. Shade for Electric Lamps. A. S. Marten, East Orange, N. J.

539,966. Electric Bell. C. B. Sterling, New York, N. Y.

540,008. Electrical Thermometer. G. C. Whipple and H. E. Warren, Newton, Mass.

540,010. Conduit Electric Railway. F. B. Widmayer, New York, N. Y.



1,027,291.—Electric Storage Range.

540,012. Telephone Central Station. G. D'Ahemar, Paris, France.

540,035. Brush-Holder for Dynamo-Electric Machines. E. Thomson, Swampscott, Mass.

540,054. Locating Faults in Electric Railways. J. G. Henry, Westfield, N. J.

540,060. Conduit Electric Railway. W. E. M. Jackson, San Francisco, Cal.

540,073. Electric Heater. C. J. Reed, Philadelphia, Pa.

540,076. Secondary Battery. W. L. Silvey, Dayton, O.

540,090. Electric Passenger Register and Recorder. J. W. Ellis, Albany, N. Y.

540,117. Conductor-Distributing Frame. T. Spencer, Cambridge, Mass.

540,153. Apparatus for Determining Differences Between Phases of Two Alternating Currents. M. v. Dolivo-Dobrowolsky, Berlin, Germany.

540,168. Electrical Exchange. A. E. Keith, A. Lundquist, J. Erickson, and C. J. Erickson, Chicago, Ill.

540,185. Secondary Battery. C. Payen, Philadelphia, Pa.

540,187. Closed-Conduit System for Electric Railways. H. A. F. Petersen. Milwaukee, Wis.

540,216. System of Electrical Distribution. E. G. P. Oelschlaeger, Charlottenburg, Germany.